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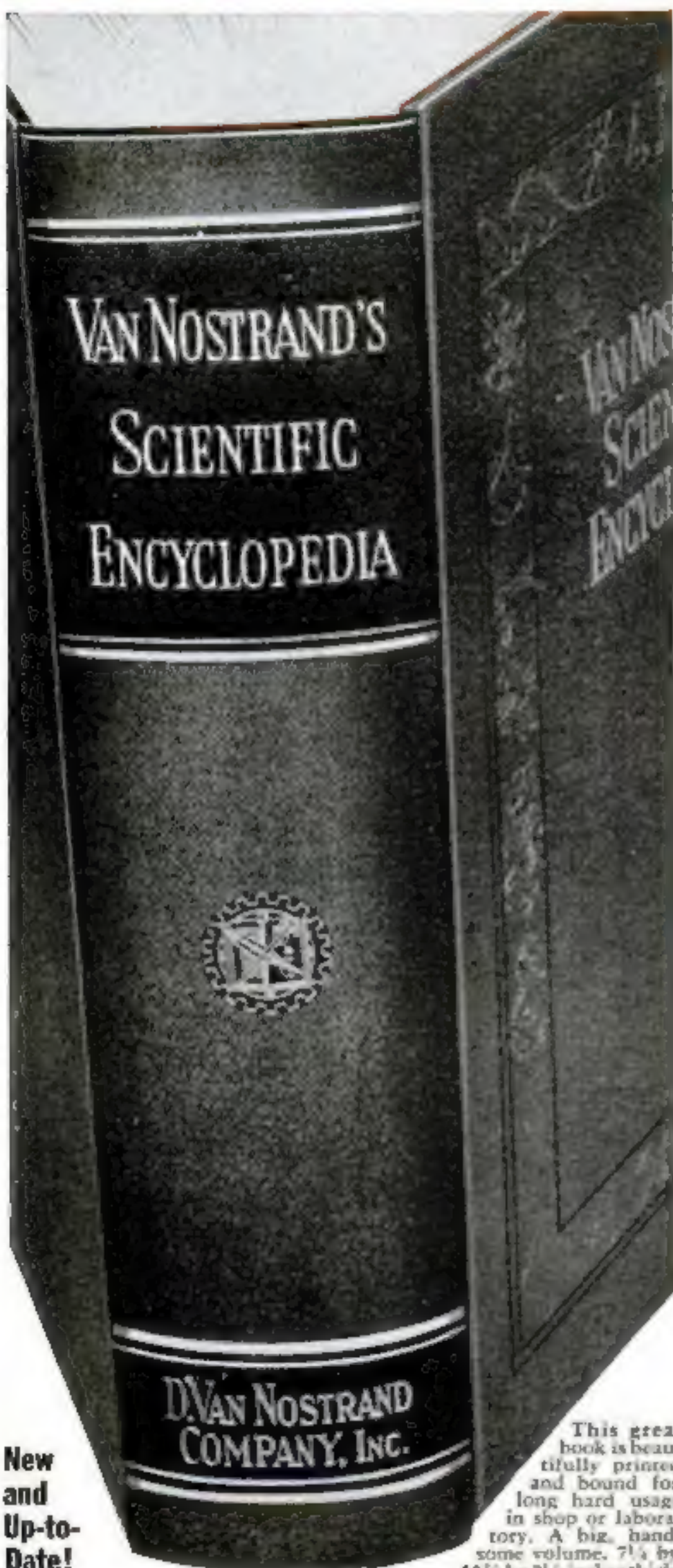


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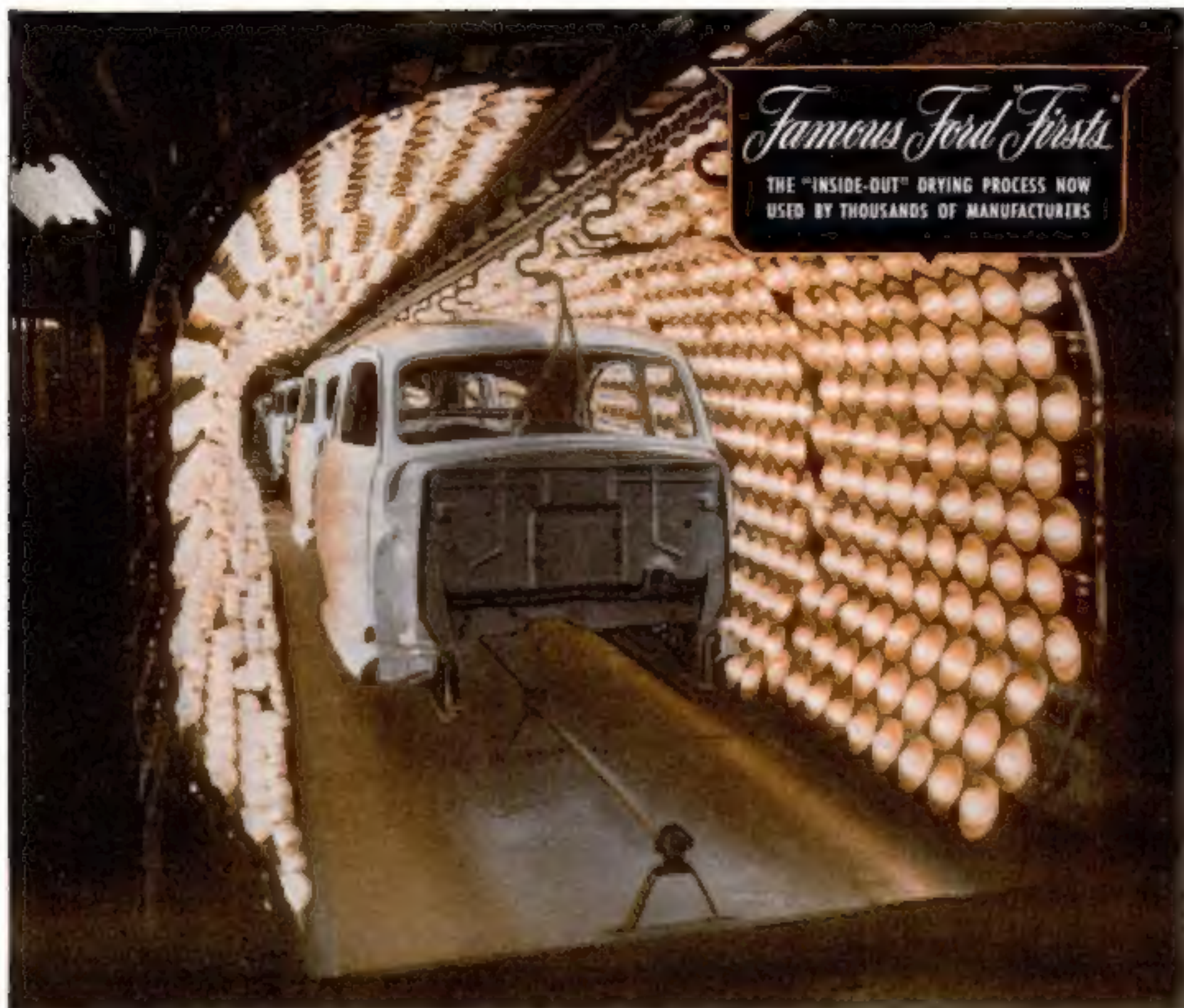
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Later the tires that had been "frozen" on Pennsylvania's winter

roads were sent to "fry" in San Antonio. Mr. Angert had to drive cross-country to a new job, on pavements that could fry eggs in less than two minutes. Most people didn't know whether synthetic rubber could take *that* either.

The tire you see here had covered 21,000 miles when this picture was taken. It has not been recapped, and Mr. Angert says he expects "at least another 25,000 miles." (That seems optimistic, but B. F. Goodrich tires have set even higher mileage records, and we can't help admiring his enthusiasm.)

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VOL. 146 NO. 3

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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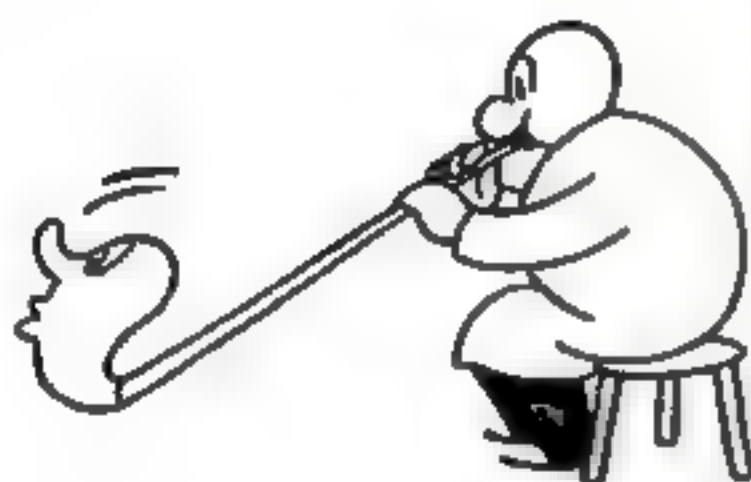
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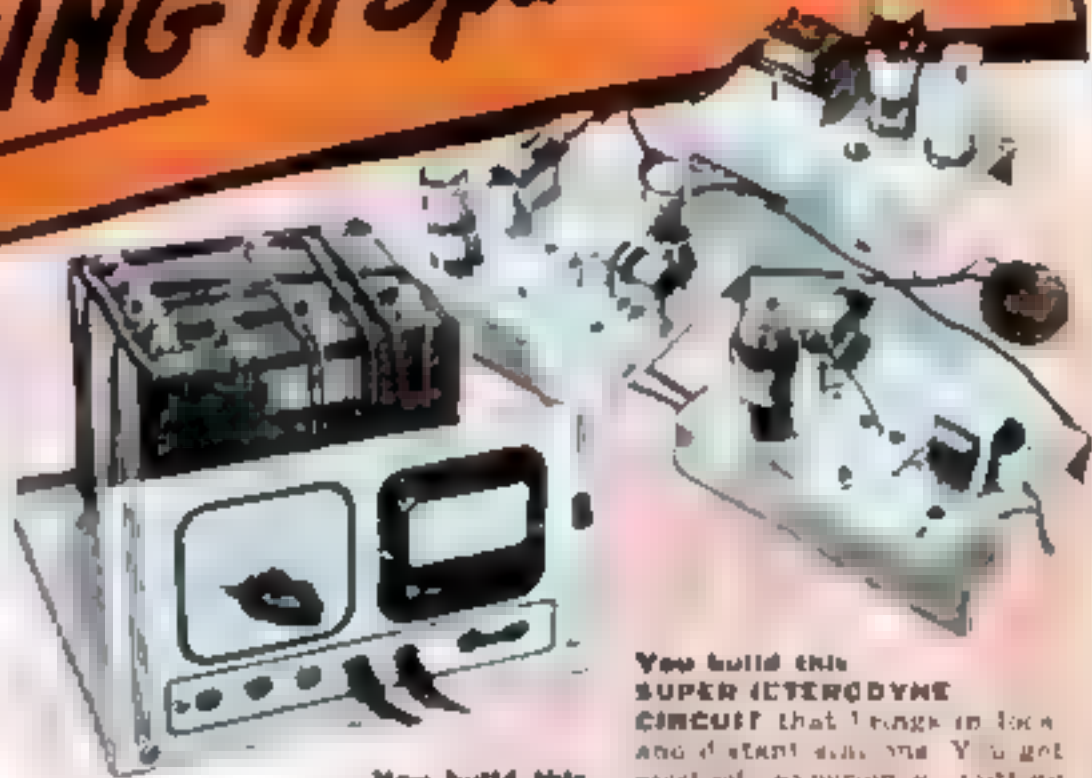
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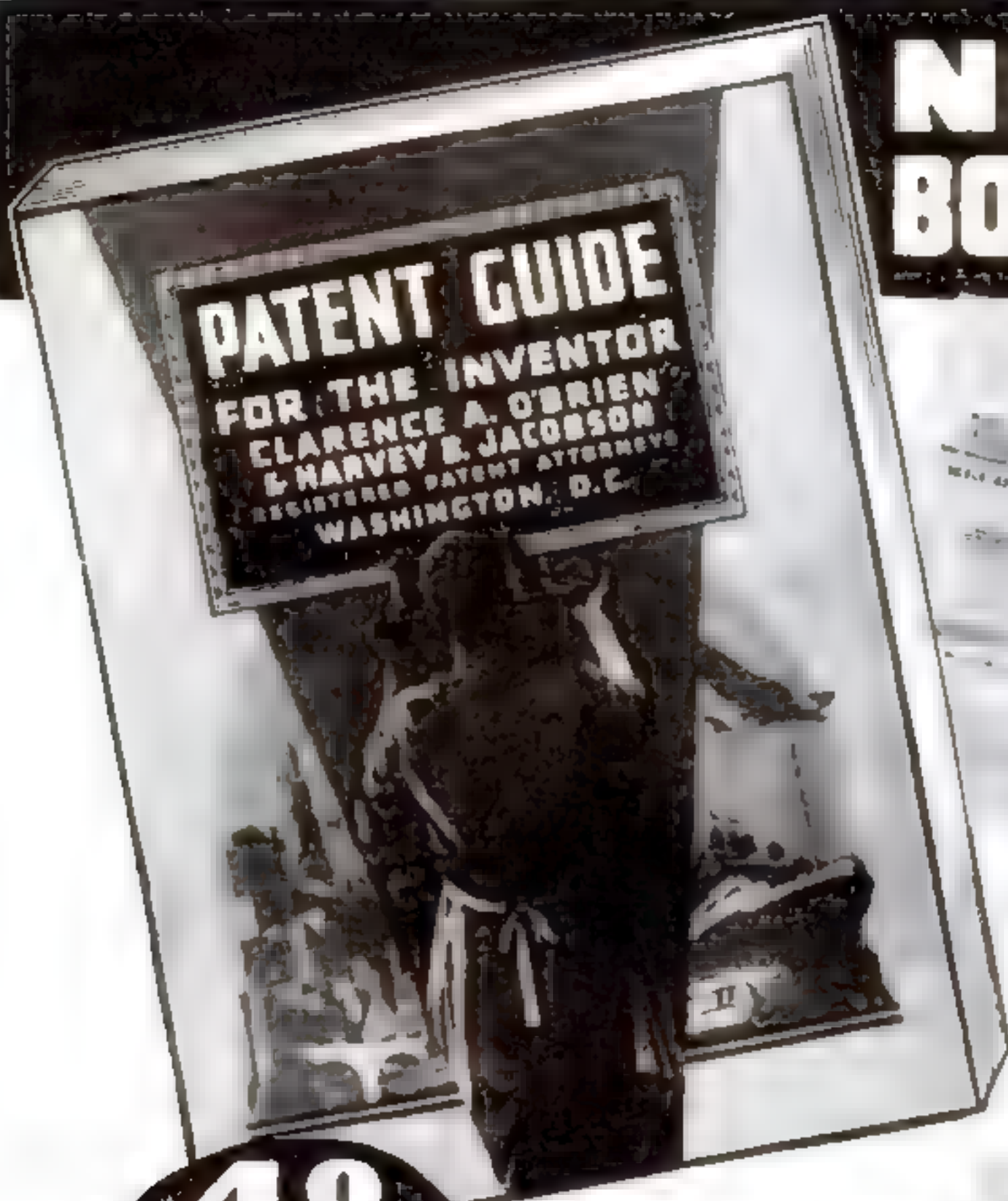
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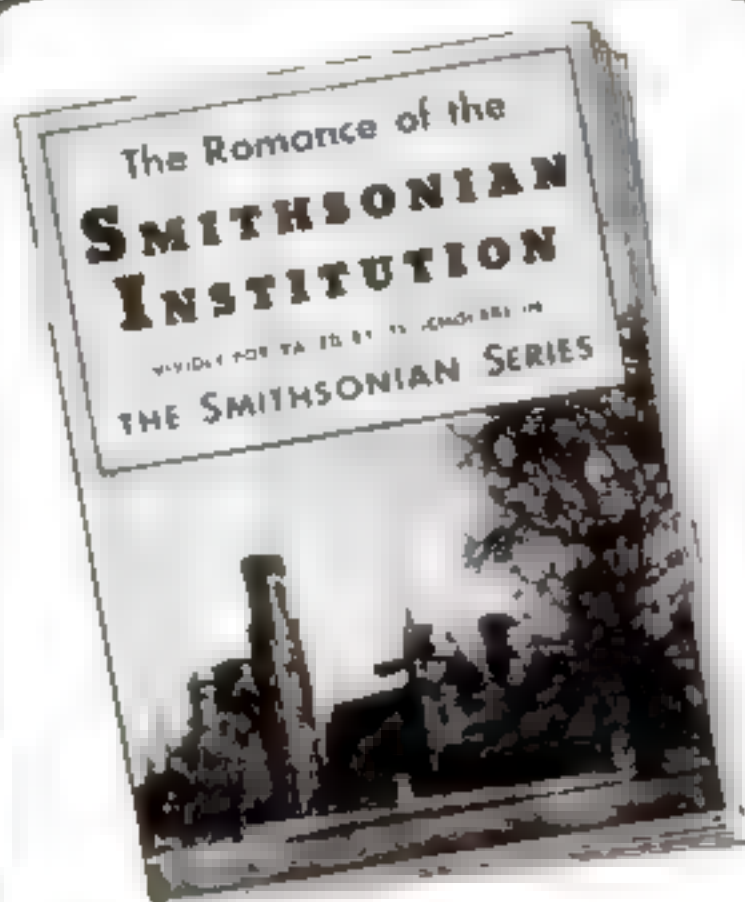
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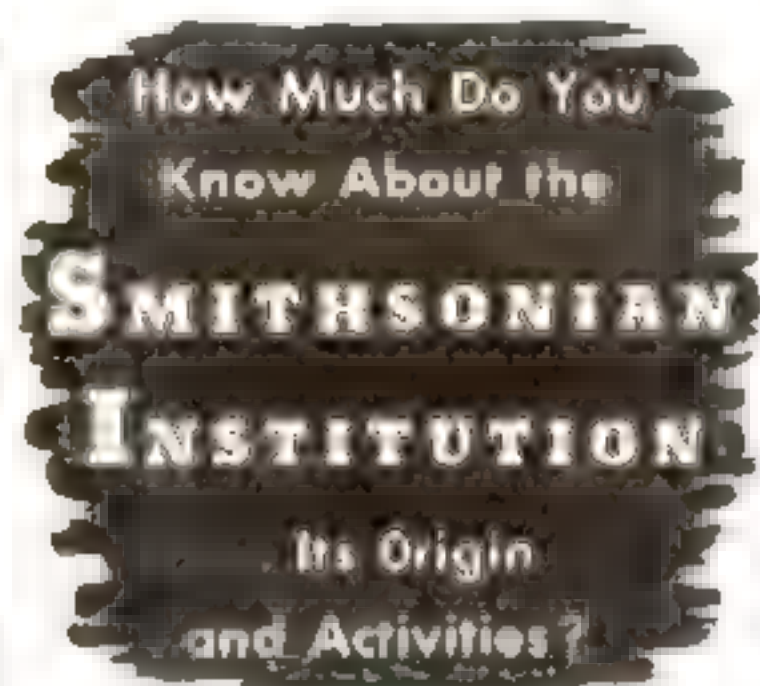
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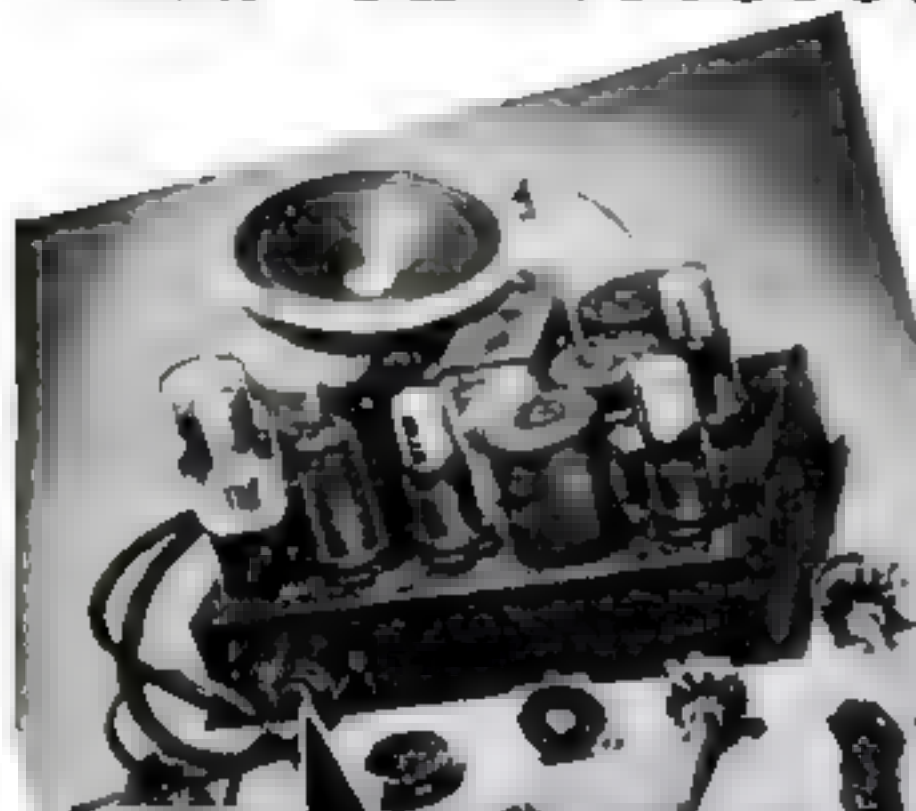
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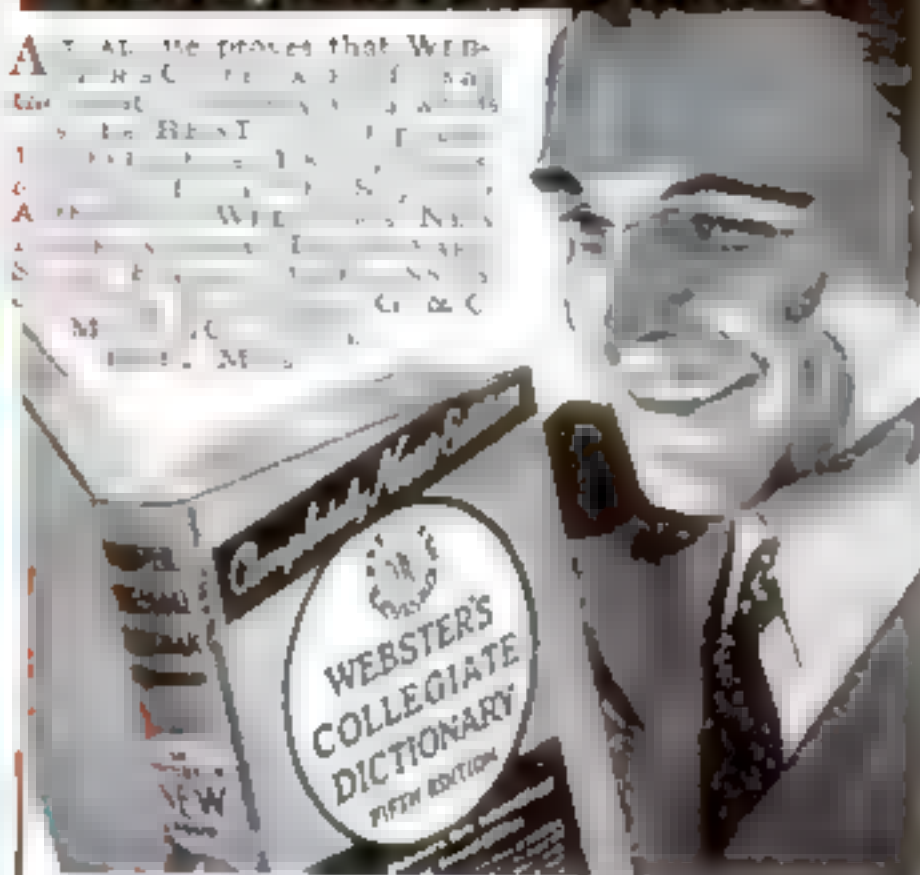
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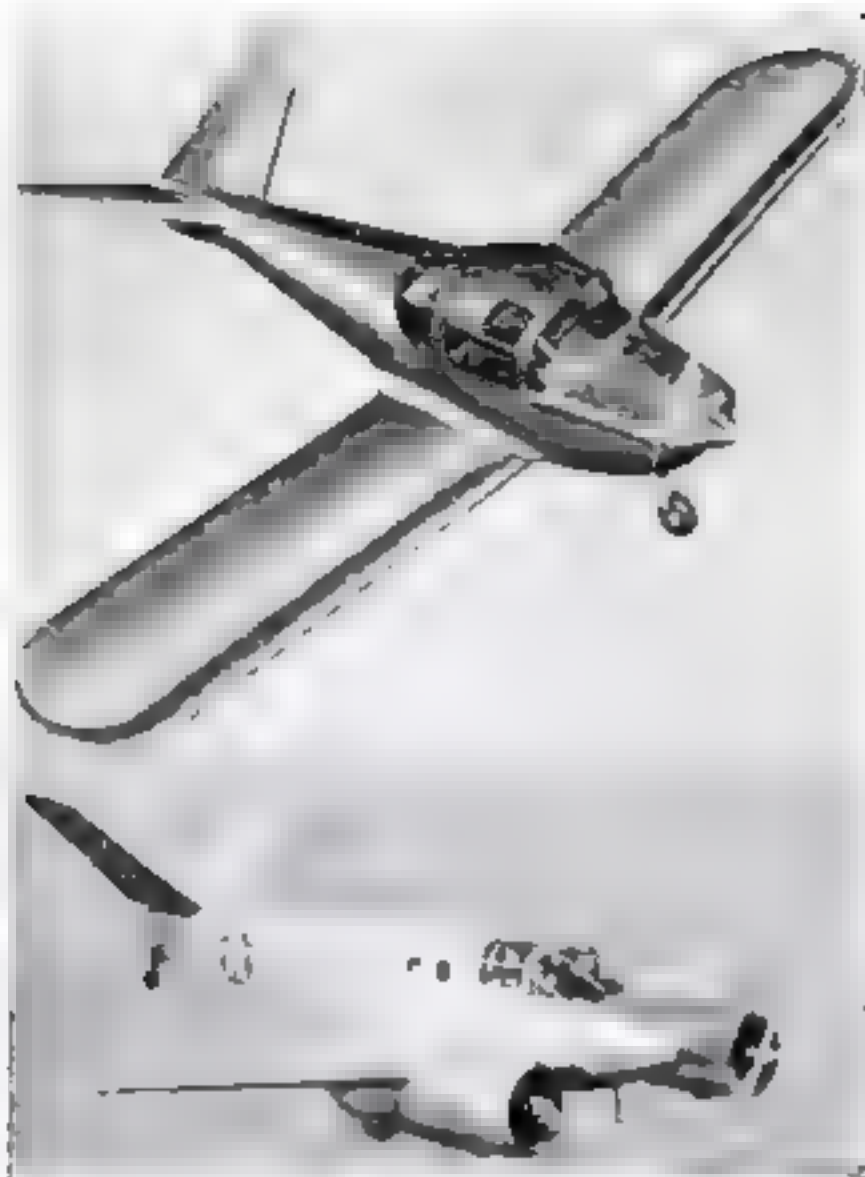
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George A. Owl's prize-winning design (top) for the plane he'd like to own featured the "ruddervator" tail. Compare it with this new Beechcraft AT-10

Postwar Plane's V Tail Is Already in the Air

I NOTE that the V-tail idea was used in one of the entries for your very interesting contest "The Plane You'd Like to Own." Of course it had been in the works here for some time before your contest results appeared, but the soundness of your contestant's idea gains striking proof from the enclosed picture of the modified Beechcraft AT-10 trainer in flight.—Wm. H. McDaniel, Beech Aircraft Corp., Wichita, Kans.

Bunk Thoughts on Molecules from a GI in France

CURIOSITY killed a cat, says the old saw, but history teaches that directed curiosity has led to many an important scientific discovery. While goldbricking on my GI bunk this morning, I gave birth to a question in abstract science. If any fellow P.S.M. reader knows the answer, I wish ye editor would let him give it in these columns.

We know that a pulsating or alternating-current magnetic field will so agitate the molecules of a piece of iron that heat is evolved. That is, a moving field causes comparatively still molecules to go into a jitterbug dance "hot" enough to melt even metals, as in the case of the induction furnace. But now suppose we start off with a white-hot

Readers Say:

piece of iron instead of a cold one. Could a powerful stationary magnetic field bring the rapidly vibrating iron molecules back to comparative rest faster than by ordinary cooling? And if so, would there be any other effect produced in the iron—an alteration in its temper, let us say, for better or for worse?

Being in France at the moment, I'm in no position to experiment, but I suspect that if a high-frequency field can cause molecular motion, then, conversely, a stationary field could be used as a "molecular brake" to arrest that motion. Who knows the right answer? P.S.M. is a great source of inspiration and vitamin-loaded food for thought.—Pfc. A. V., New York City

P.S.M. Molded His Career—and in Plastics, Too

As a regular reader of P.S.M., I felt that a bond existed between me and a young man who sat beside me on the bus. He was carrying copies of the magazine. So I said, "What do you think of that book?" "I like it fine," he replied with enthusiasm. "Been reading it for several years. In fact, it was through POPULAR SCIENCE that I got into my present work." I asked him what that was, and he said, "Plastics." Thought you'd be interested to know that you people at P.S.M. are helping to shape careers.—E. F. Z., New York City.

Another Plane-Contest Winner Tells About Himself

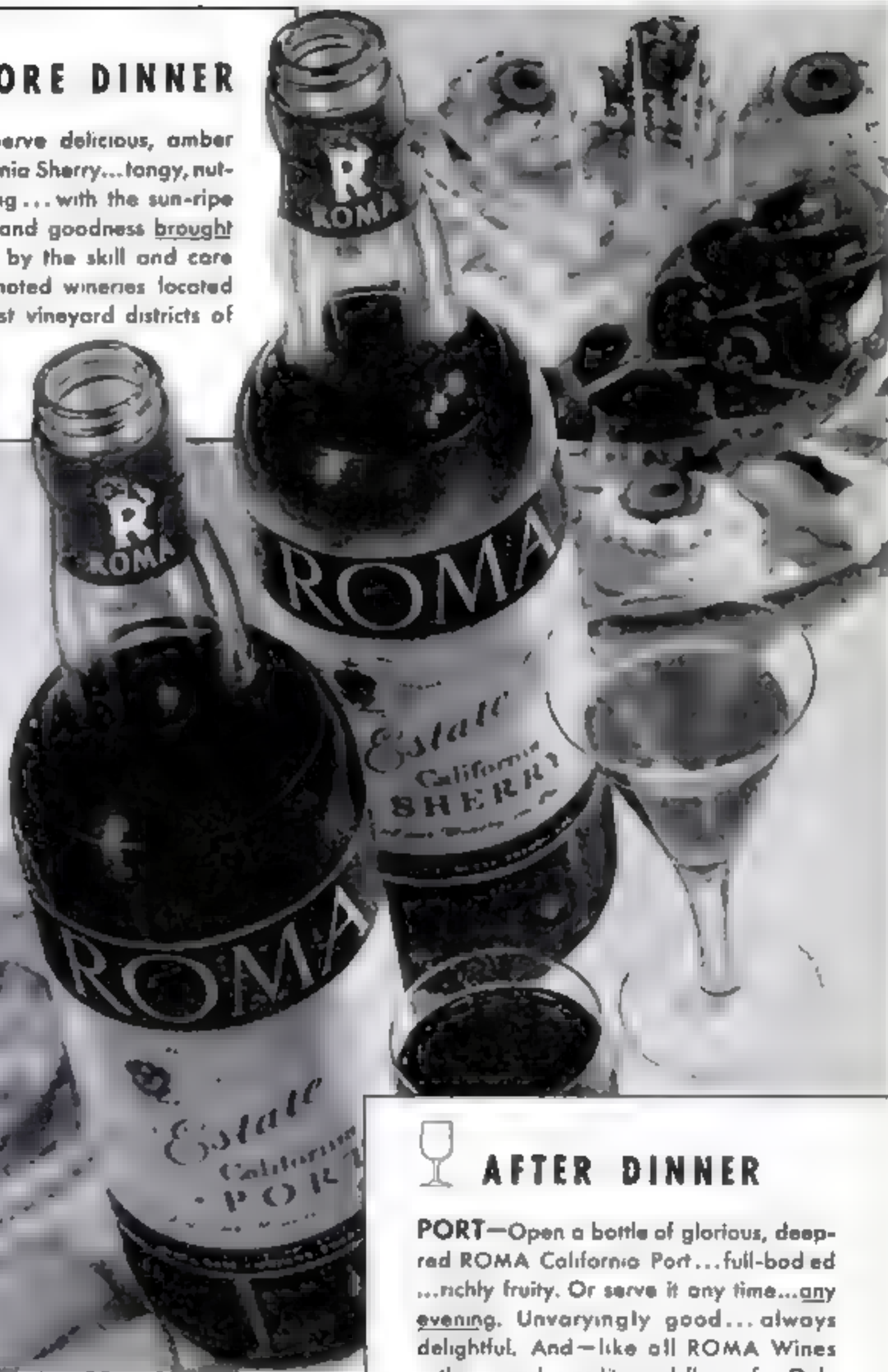
You may be interested in the following information about me that was not included in P.S.M. with reference to my winning second prize (professional class) in "The Plane You'd Like to Own" contest. I am 24 years old. Prior to entering service, I was employed as inspector by the Glenn L. Martin Co., Baltimore, Md. I have studied some mechanical and aeronautical engineering, and hope some day to become an aircraft engineer. At present I am studying aviation metal-smithing in the Navy.—Robert C. Kelley, S 2/C AM., Class 23A, N.A.T.T.C., Norman, Okla.





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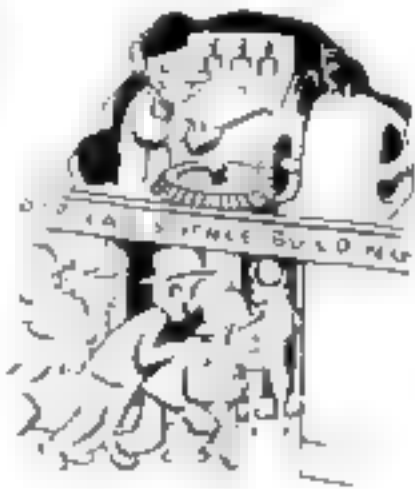
Two Readers with But a Single Thought—and a Good One

Your new visual filing aid—a red stripe on the back of *POPULAR SCIENCE MONTHLY*—is excellent, and I want to compliment you on this idea. However, may I suggest that the stripe for ensuing years should be of various colors so the books may be easily segregated as to years as well as months? Or the stripe may be a diagonal in the opposite direction for the following year, so that a two-year group will form a large V. "Readers Say" is the first section of *P.S.M.* that I read. How about a little more of this department?—A. F. Warren, Pa.

I THOUGHT the idea of the stripe on the back of *P.S.M.* was swell, and I dashed out to show my wife the picture of the rack and magazines. She liked the idea, but said, "Why don't they make the stripe a different color for each year?" Well, why not? I look forward to many more years of pleasure in *P.S.M.* and the new idea.—C. E. C., Larkspur, Calif.

Revolving-Door Generator Seems to Have Drawbacks

I would like to make a few comments on J. H. Van B.'s letter, in which he suggested gearing up generators to revolving doors to supply electricity to storage batteries, which would in turn run the neon signs, thus saving coal for the power companies. I suppose it would save a little coal, but the extra energy required to use the revolving doors would have to be supplied by the people using them. This would mean that these people would need to consume enough extra food to make up for this energy, so instead of wasting coal, we'd waste food, and, as well, have to use batteries and generators needed by our armed forces.—H. E. S., Dupont, Ind.



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Readers Say:

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Molecules Bump Their Little Gums and Light Up the Place

TELL S. F. C., Jr., that the Scotch Tape phosphorescence phenomenon is caused by molecular friction; just the molecules of sticky cement bumping their little gums against the cellulose material of the tape when he jerked it away from the wall. Unroll a package of black friction tape in a dark room and you will see a line of fire where the tape separates from the roll. Jerk it a little at a time and the fun lasts longer. You can generate static electricity this way, too. Disconnect the ground wire of your radio, but retain the aerial if there is any; then turn the volume way up, and tune off the station. Now unwind your roll of tape close to the aerial post. If you do this on a very dry day, you'll get the most awful noises you ever heard. This is worth the work of rolling up the tape again.

Did you know that you could crush a lump of sugar in the dark and get a distinct glow? You can; it's sort of purplish white most of the time. When the little molecules are pulled or pushed that violently, their cries are so high-pitched that they generate light instead of sound. I hope this explanation pleases S. F. C., Jr., and will give him some fun as well.—O. P., Jefferson City, Mo.

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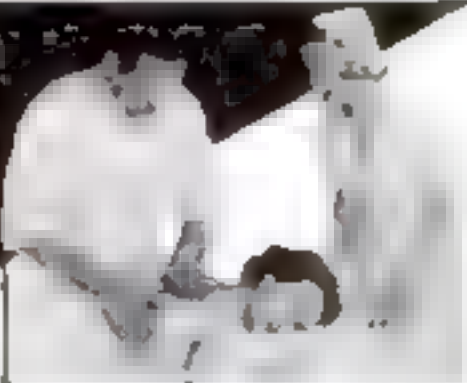
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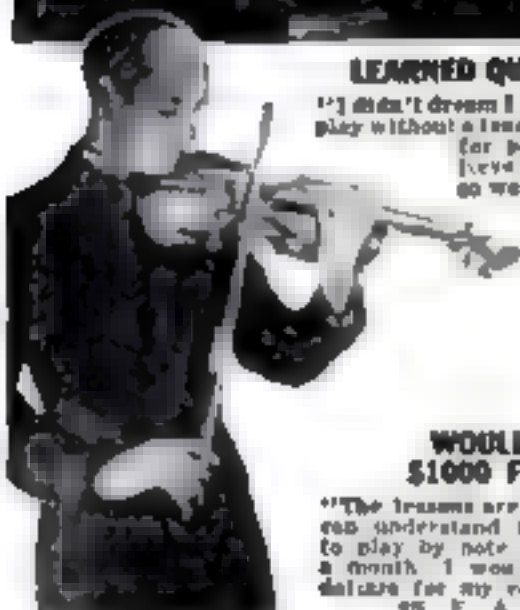
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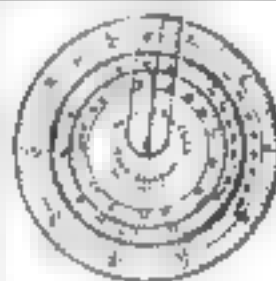
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By S. T. CHRISTENSEN

the "Fix-it Man"

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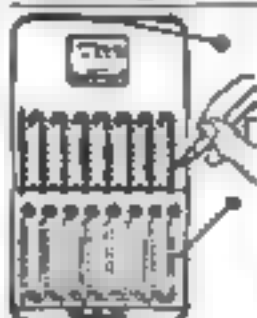
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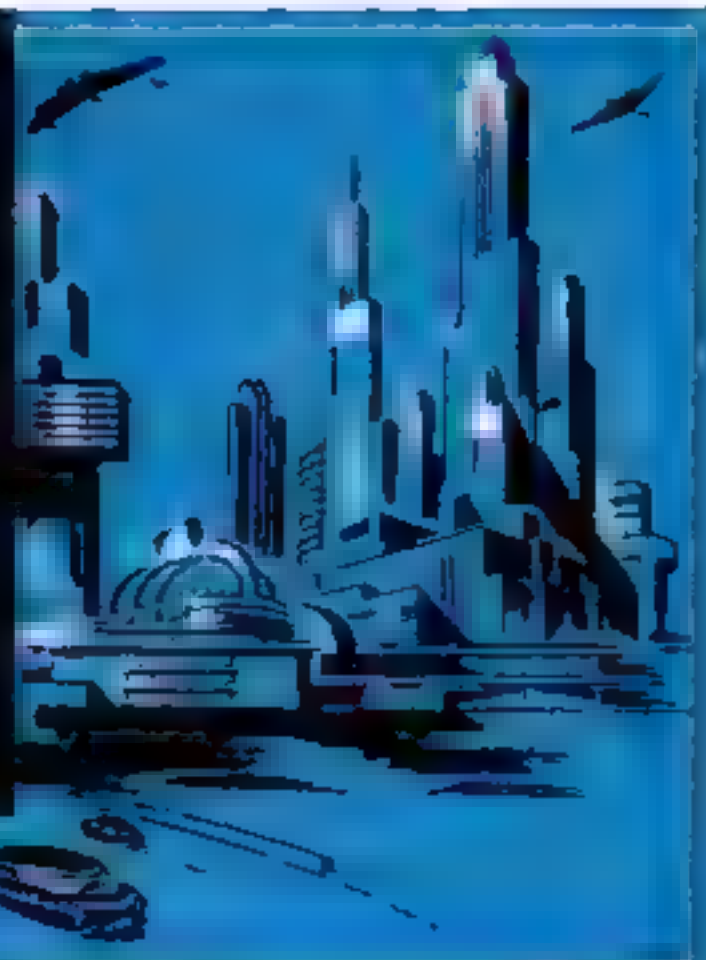
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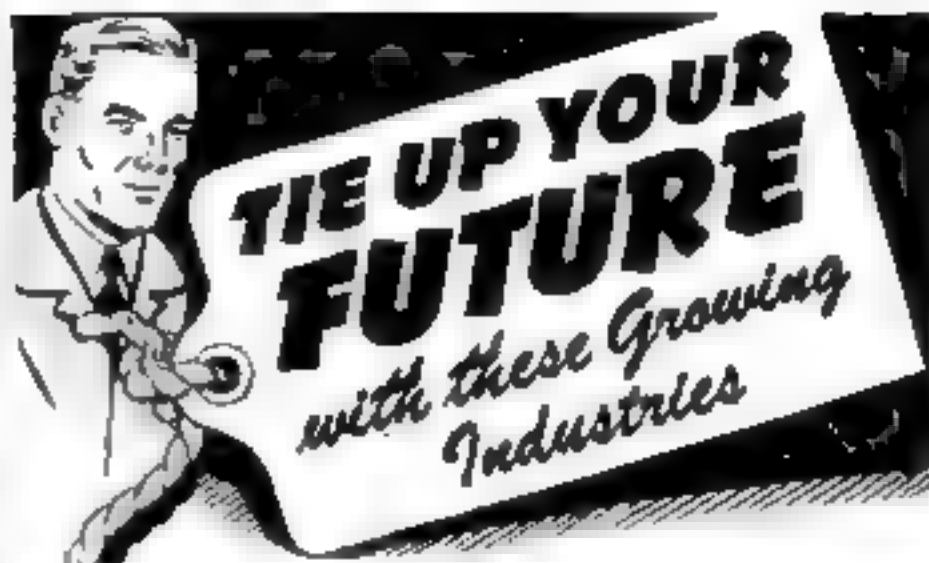
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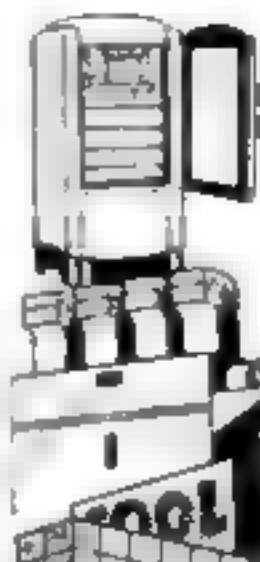
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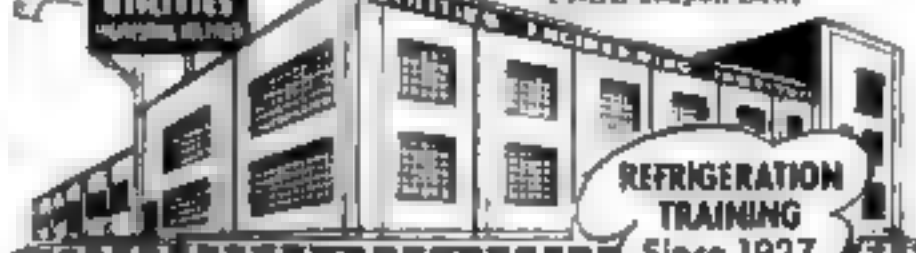
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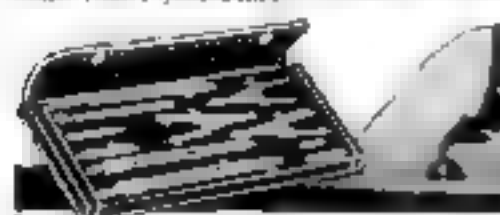
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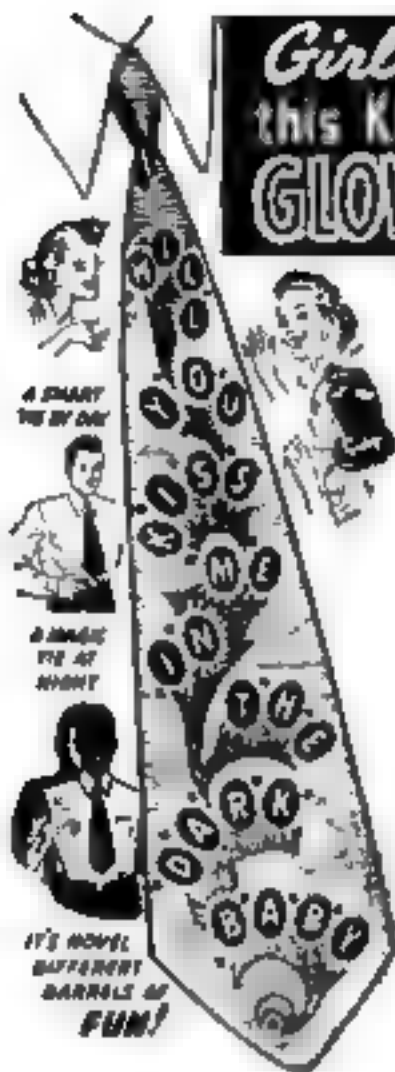
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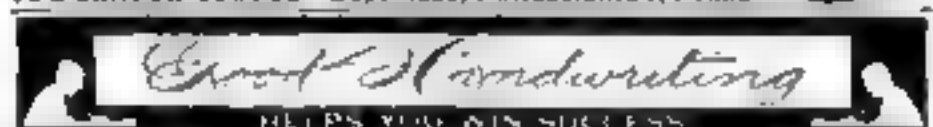
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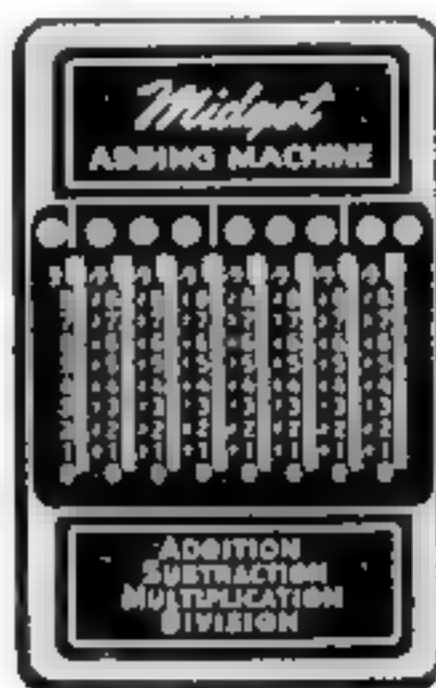


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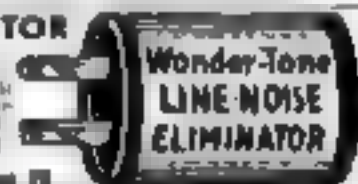
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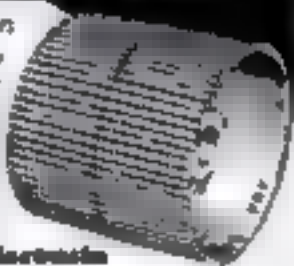
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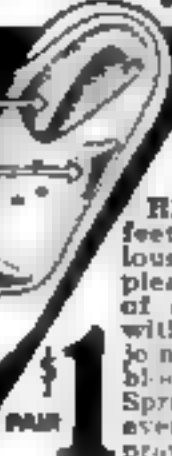
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What's in the Basement of the World?

We're finding out through an amazing invention that plunges miles deep to photograph the ocean's floor.

By VOLTA TORREY

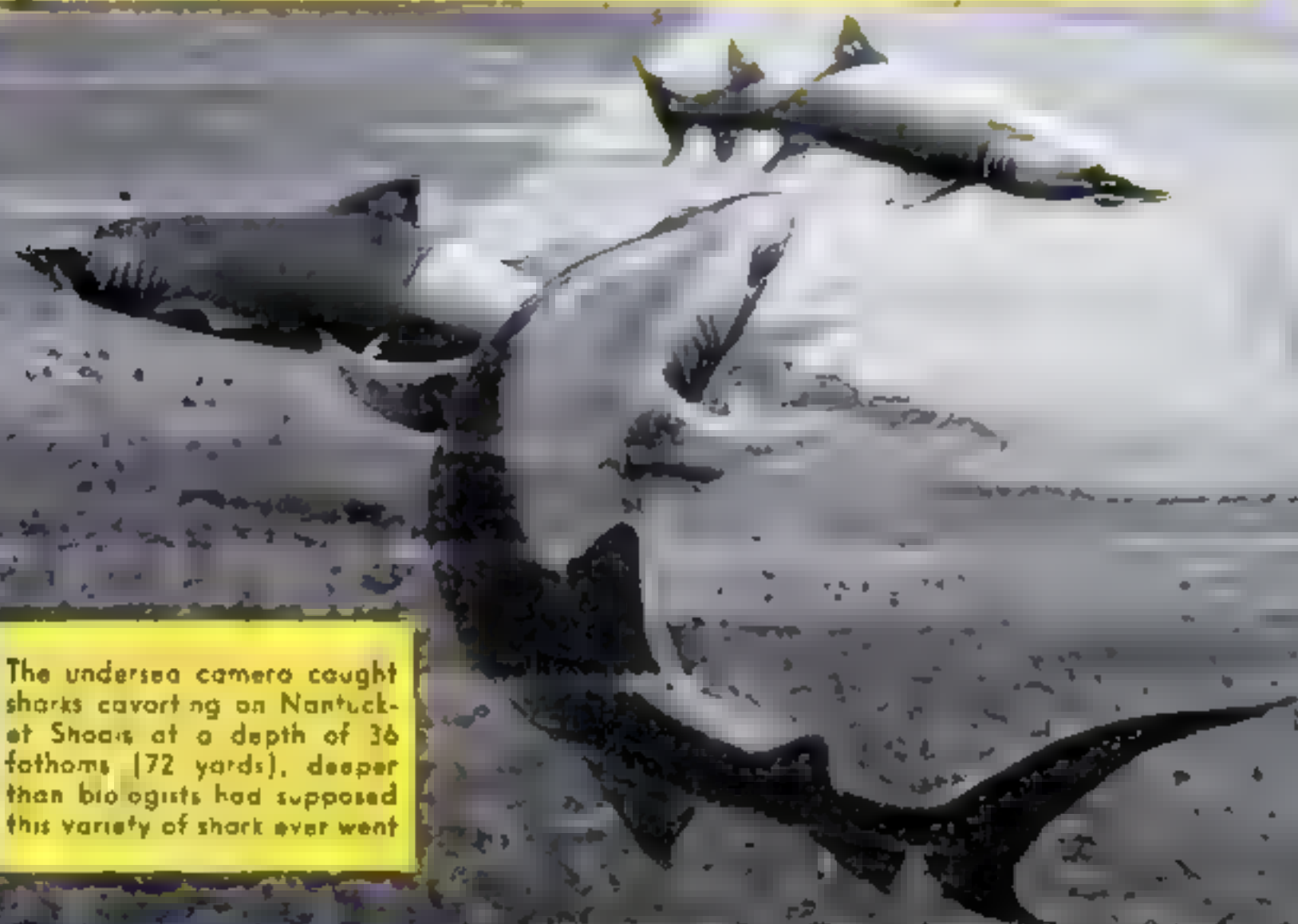
NEARLY two thirds of the earth's surface is still unexplored, because it is hidden beneath a mile or more of water. By delving deeper into the oceans, we can learn as much about the birth and evolution of the world as by peering farther into the heavens. Clues to the origin of continents, location of petroleum pools and other natural resources may be awaiting discovery beneath the seas, along with sunken ships and treasure chests. And now, ways have been found to examine this tremendous basement photographically.

Already, pictures taken far below the ocean's stormy surface have modified some of the ideas of both geologists and biologists.

Further study of the 139,000,000 square miles of plains, peaks, and canyons concealed for centuries by salty water may cut in half the number of theories as to the earth's origin.

Yet, compared with a 200-inch telescope, the apparatus used to photograph an ocean's bed is absurdly simple. A *POPULAR SCIENCE MONTHLY* staff writer, who was permitted to examine this apparatus at the Woods Hole Oceanographic Institution on Cape Cod, found that it consists of an ordinary little camera, inexpensive photo-flash bulbs, and other commonplace items, hung on a pole. But the ways devised to manipulate this equipment are amazingly ingenious.

The pressure of the water increases about a half pound per foot



The undersea camera caught sharks cavorting on Nantucket Shoals at a depth of 36 fathoms (72 yards), deeper than biologists had supposed this variety of shark ever went

as you descend into the sea; few divers can go down more than 200 feet. Sunlight penetrates only a thin upper layer; below 600 feet, the temperature is generally near zero centigrade, and only the terrific pressure and the salinity keep the water from freezing. Sending a camera to the bottom of this enormous, dark, cold, heavy, restless mass, snapping a clear picture, and recovering the camera entails a whole series of neat tricks.

Nevertheless, Dr. Maurice Ewing, Allyn Vine, and J. L. Worzel, three geophysicists now working at Woods Hole, have obtained a huge albumful of portraits of the ocean's floor. They have taken pictures at a depth of three miles, which is several times as far as William Beebe descended in his famous bathysphere. And they believe they have acquired the know-how needed to photograph the deepest pits, which extend farther down below the surface of the ocean than

the highest mountains soar above sea level.

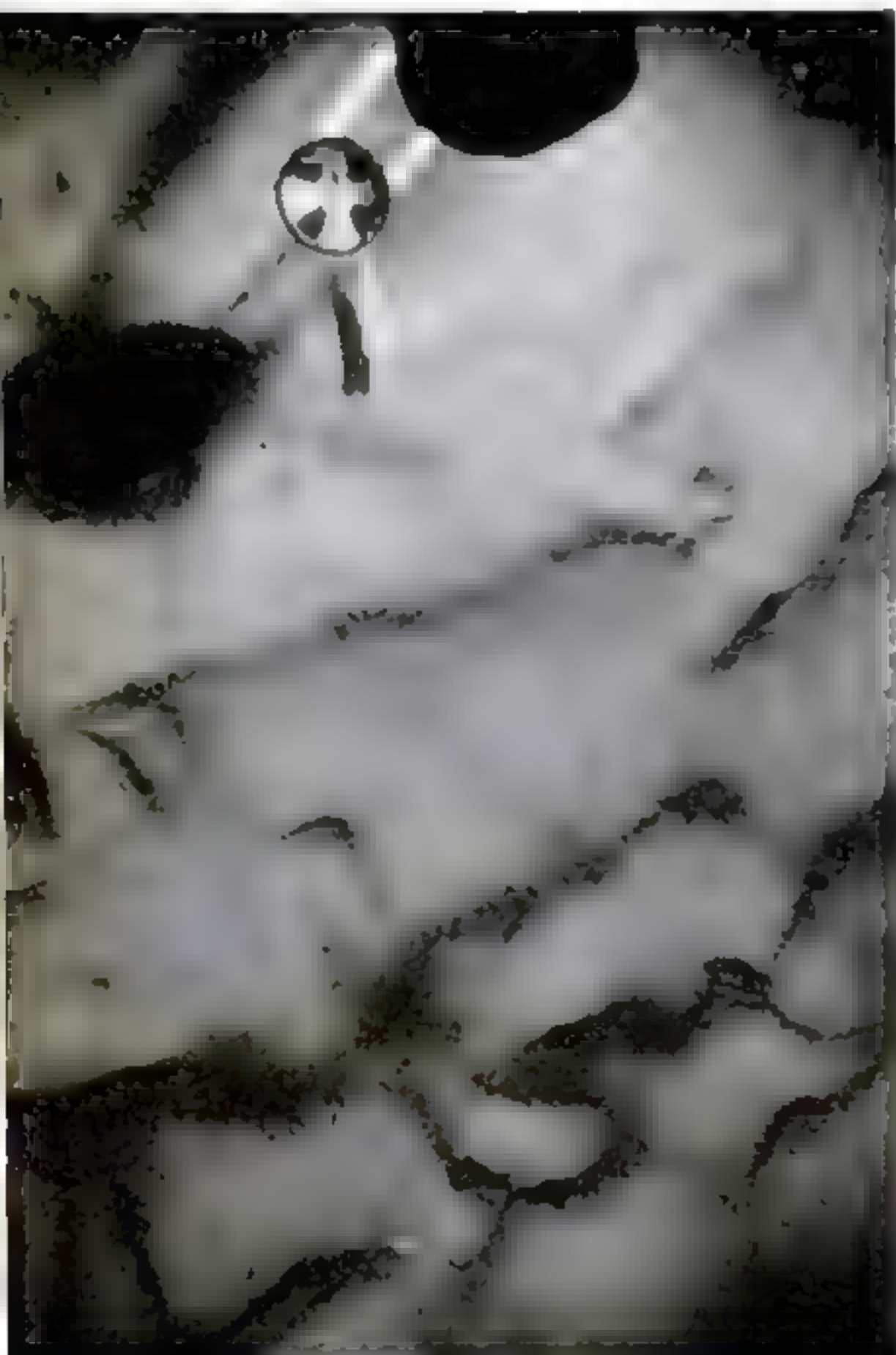
They embarked on this work in 1938, on their way home from coastal survey voyages. They lost their first expensive cameras, and had to finance many of their experiments themselves. So they now use a simple little Argus. To shield it from the water's crushing weight, they mount it in a tight steel or aluminum cylinder, or seal it in a big glass test tube. To keep moisture from condensing inside it, they enclose a bit of calcium chloride or some other drying agent. And to keep bubbles off the window, they cut slots in the metal rim around it, into which any air remaining on the glass when it is submerged is forced by the pressure of the water.

But, as they explain now, "The chief problem is not optical in character, nor one of camera design. It is to find an interesting subject and to put the camera in focus with it, to provide proper illumination, to hold the camera reasonably steady while the exposure is made, and to get the camera back afterward."

As geologists, Dr. Ewing and his associates were interested in views of the terrain under the sea. So they pointed their lenses downward, directly at it. They then solved the focusing problem by hanging the camera on a pole and focusing it on the earth at the lower end of the pole. For illumination, they hung photoflash bulbs on the same pole.

In comparatively shallow water, they can suspend this scientific

SAND-RIPPLE PORTRAITS, made 51 fathoms down, are called one of the underwater camera's most significant discoveries. Similar ripples have been found as far as 83 fathoms below the surface. Until pictures like this were obtained, geologists doubted whether waves rippled the sand more than 30 fathoms down



CAMERA HITS BOTTOM and stirs up "dust." The first picture looks that way, but the dust is really sediment stirred by the camera pole coming to rest



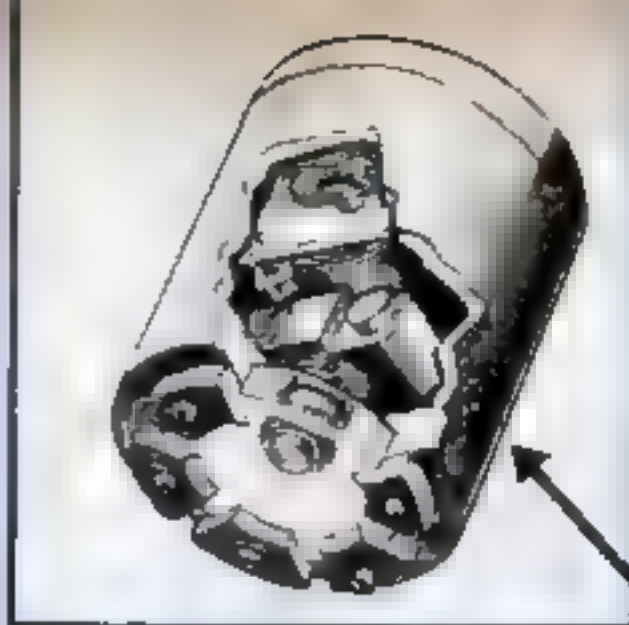
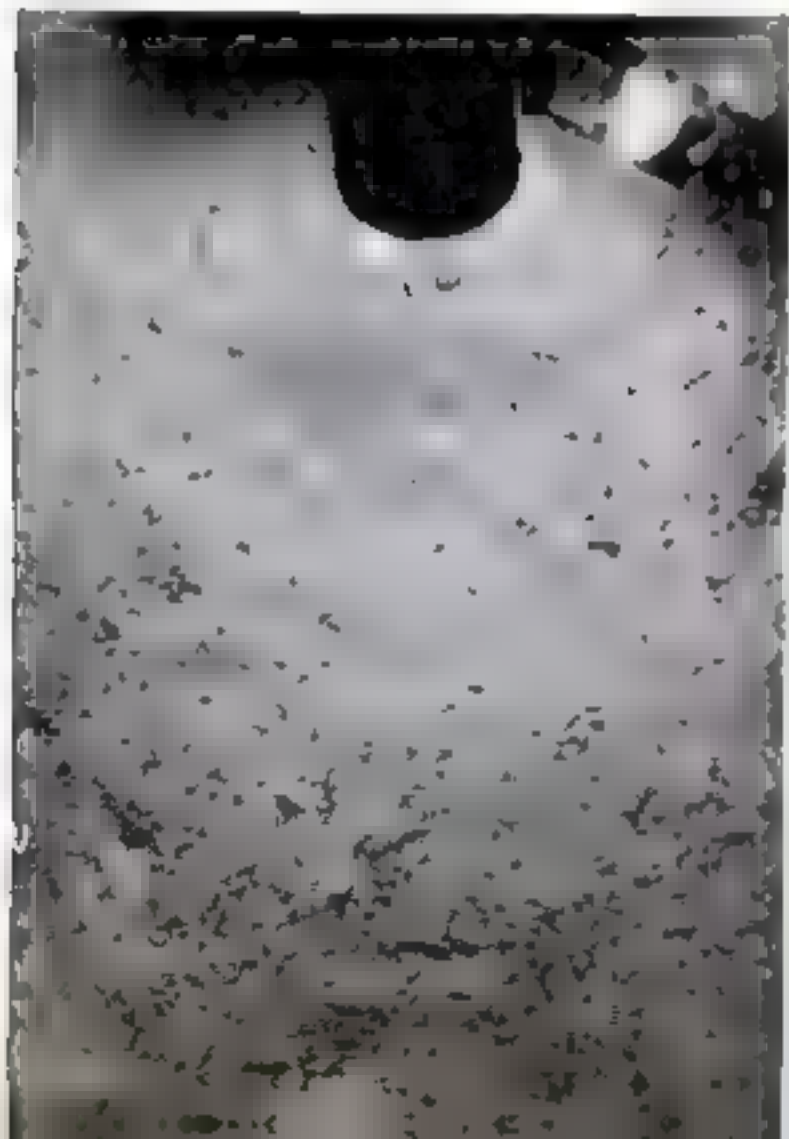
Christmas tree from the side of a ship on a wire. A tiny sail attached to the pole keeps it from twirling, and a trigger on the lower, weighted end of the pole turns the lights on and flicks the shutter when the bottom is hit. The photographers then hoist it back to their ship and see what they've got.

But the weight of the hundreds of yards of wire that may be needed to lower a 12-foot pole to the bottom of the ocean makes dangling the equipment this way too difficult and uncertain. So, in really deep water, they just throw the whole thing overboard.

When this must be done, they rig the pole differently. The weight is attached in such a way that it will fall off after it has dragged the pole to the bottom of the oceanic cellar and one or more pictures have been snapped. And a float is put on the upper end of the pole to lift it back to the surface after the weight has been dropped.

The automatic ballast release consists of a chunk of salt in a tin can nailed to the pole. The salt is placed in a cloth sack, from which a wire is run through a hole in the bottom of the can to the weight. When the water

HALF A MINUTE AFTER picture at the left was taken, the water became clear. The light, seen at top in both pictures, shows a starfish and clam shells



UNDERWATER CAMERA is mounted in a tight steel or aluminum cylinder, or a big glass test tube. In this drawing, artist Seielstad has idealized the makeshift apparatus

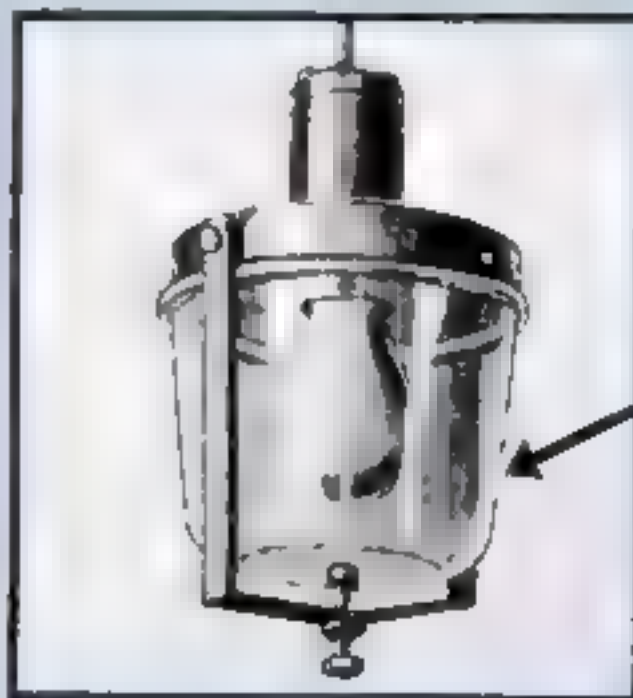


FLOAT



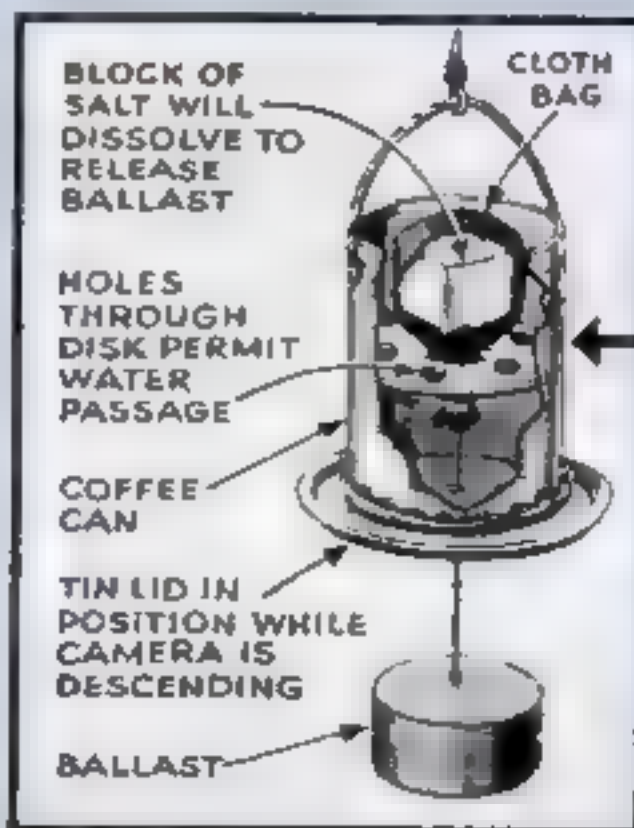
CAMERA

LIGHTING for the deeper shots is provided by little flash bulbs in glass receptacles exactly like the sediment cups on motor-car fuel lines



LIGHTS

BALLAST RELEASE consists of a chunk of salt in tin can. Salt is placed in a cloth sack, from which a wire extends to the weight through a hole in the can's bottom. Weight is freed when the salt dissolves



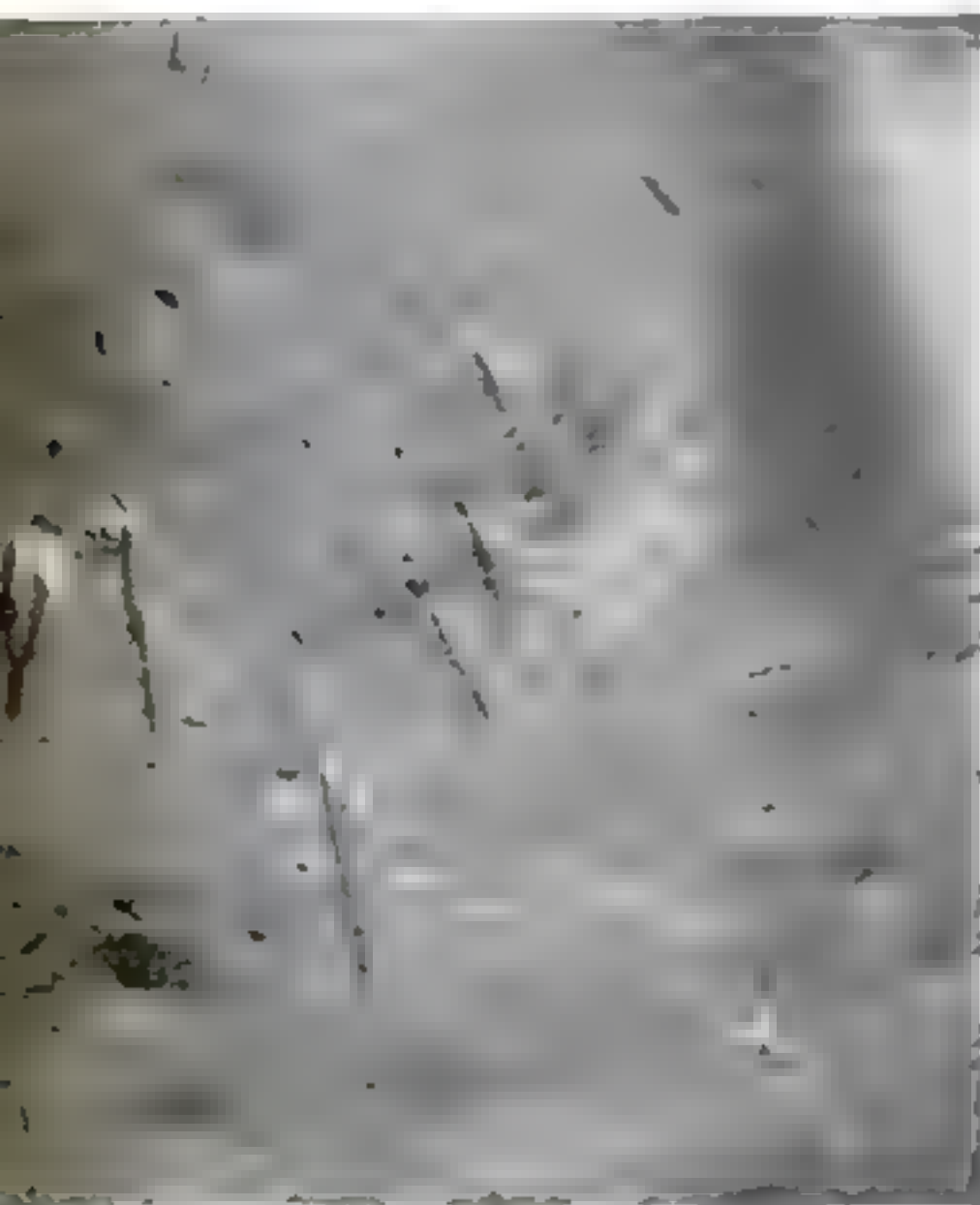
BALLAST RELEASE



BALLAST TRIGGER



TRACKLESS DEEP? It's hardly that, because this picture shows a definite but mysterious track photographed 106 fathoms under the waves. Subsea photography has revealed many such unexplainable markings



SEA FERNS, formerly thought to thrive only off the English coast, were photographed growing at 50 fathoms in our Atlantic waters—first proof of this fact

CURRENTS half a mile deep are photographed as they move a rig made of a triangle holding a compass and three ordinary table-tennis balls



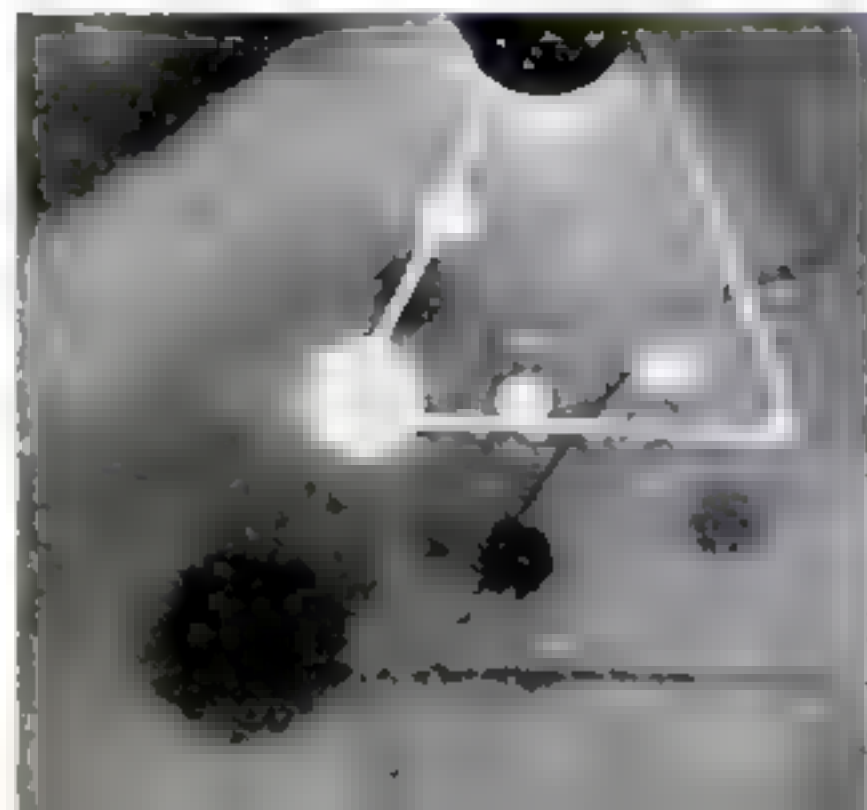
A 40-FATHOM STARFISH portrayed by Dr. Ewing's underwater camera. Biologists have been surprised to find thick beds of starfish, oysters, and sand dollars in the lower levels of the ocean

dissolves the salt, the sack slips through the hole, and the weight is no longer attached to the pole.

Blocks of hard salt like those placed in pastures for cattle are cut into 1½-inch cubes for this unusual purpose. The time that it will take the sea to absorb this much additional salt can be estimated with sufficient exactness for the cameramen's purposes. They also have used clockwork and a magnetic device to trip a trigger and release the ballast, but they prefer the salt system because it is cheap and reliable.

The buoy used to bring the camera back up also is ingenious. It is made from a few feet of Neoprene hose such as is used for loading tankers. This hose is sealed at each end and filled with gasoline. Even the weight of miles of water will not compress the gasoline greatly, and the lower reaches of the ocean are so cold that there is no danger of an explosion. High-test aviation gasoline is used when it is available, but ordinary gasoline will do. It is enough lighter than salt water to boomerang the camera pole back to the surface.

Even so, the round trip to the bottom may take three hours—and the pole is not likely to bob up right (*Continued on page 216*)

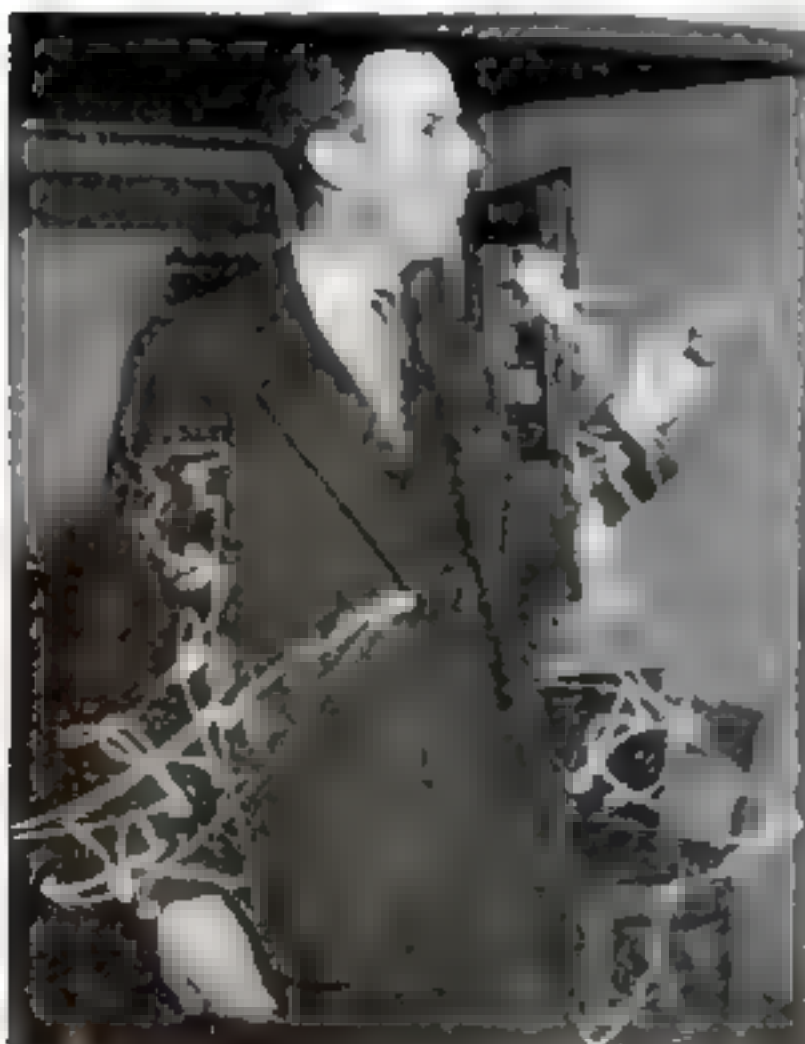
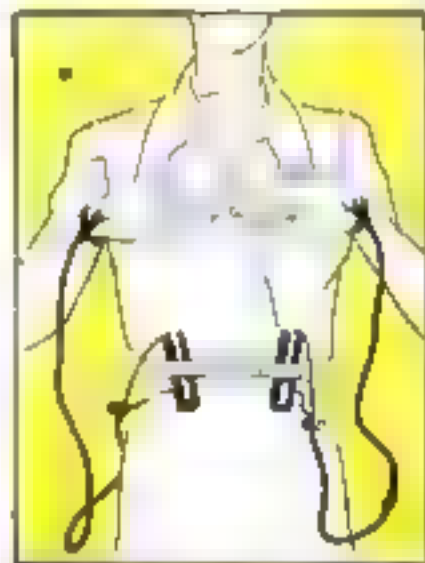




Trails of light show what a simple matter it is for a woman to fix her hat

Lights Trace Hand Motions

COMMON actions, such as lighting a cigarette or tying a shoelace, involve a surprising amount of complicated hand movement. Photographer David McLane proves it by attaching lights, as at right, to the wrists of a subject, who performs the action before a camera in a darkened room. After the pattern has been traced on the film, he makes another exposure with a flash bulb to light up the subject.



Here the camera has recorded the motions involved in lighting a cigarette, tying a shoelace, and ironing a towel. In picture at left 'doodling'-like lines represent fumbling for the match. A Rose is seen near cigarette





The Plane of Tomorrow Smells Like an Oil Stove

"A plumber's nightmare!" That's what any old-time ground-crewman is likely to say the first time he sees the innards of the jet plane. But he has to admit that for simplicity of maintenance and repair the squirt job has its points.

By S/Sgt. EDWARD T. WALLACE

Condensed from AIR FORCE, Official Service Journal of the U. S. Army Air Forces.



Simplicity is the keynote of the jet engine. That means easier and quicker maintenance on the ground



Four men can pull both engines of a jet job and install new ones in a day—a task that might take five days with a conventional plane. Jet mechanics use about five wrenches where 25 would be needed on a regular fighter

THE P-51 mechanic, curiosity and perhaps a trace of contempt written on his features, squatted under the wing of the jet-propelled plane and ran an eye over the flame tube. Other mechanics were installing an engine in the jet job.

S/Sgt. Earl Kohler, in charge of the project, glanced up.

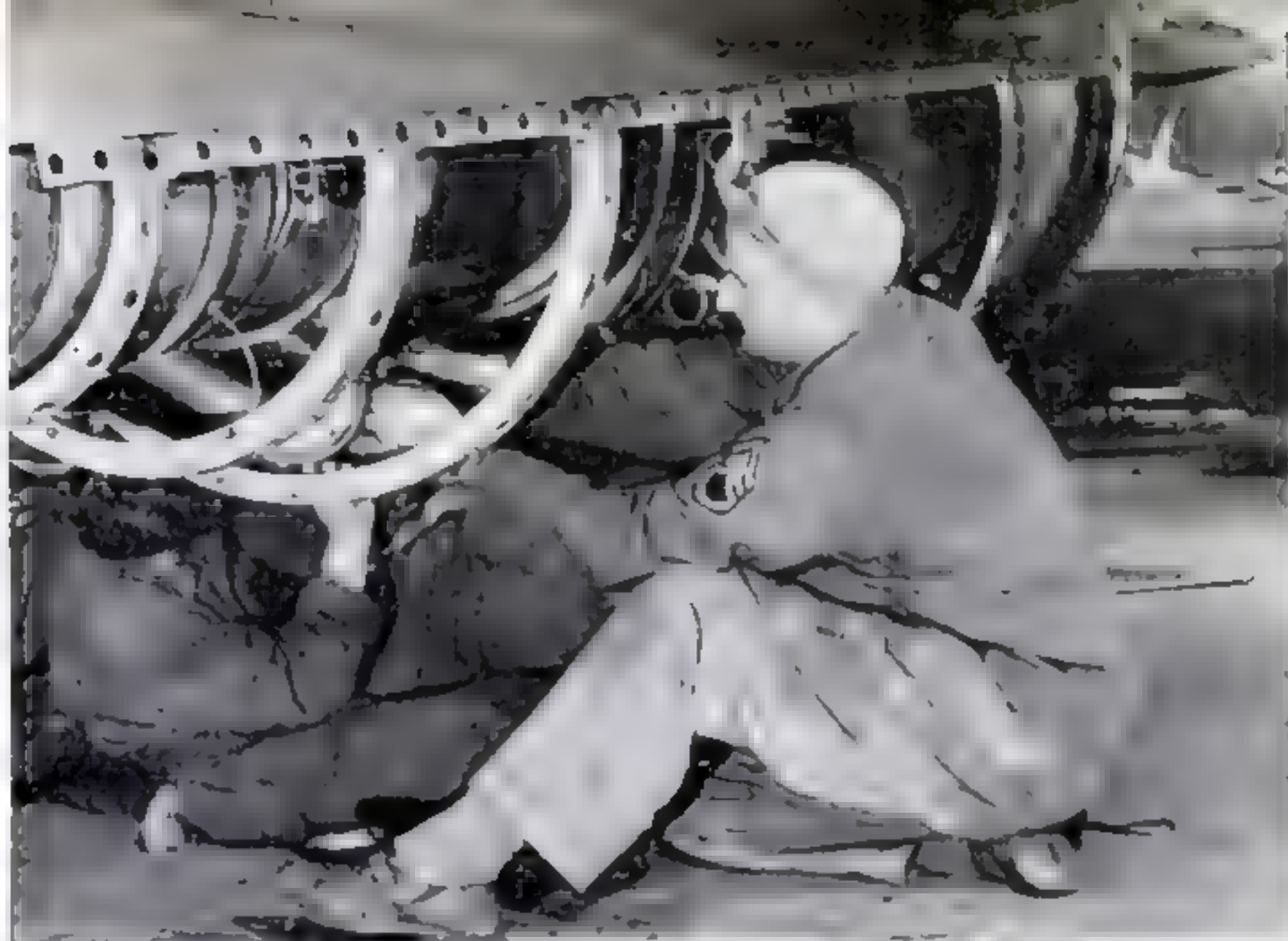
"How does she look, Bill?" he asked the Mustang man.

"Well," came the considered reply, "I'd call that a plumber's nightmare."

That was early in the history of jet propulsion in the Army Air Forces. Since that day, mechanics on conventional fighters and bombers have asked Kohler and his crew a million questions about servicing the jet plane.

"They want to know," says Sergeant Kohler with some impatience, "what wrenches we use. How long it takes to pull an engine. How the jet works. One guy even asked if it uses fuel. All kinds of damn fool questions."

Kohler, who operated a garage for 15 years before he went into



One of the jet engines of the P-59. Development of the Airacomet was one of the best-kept secrets of the war. "Every time I turned around," a mechanic says, "I was signing some promise to keep my mouth shut."

the Army, was one of the first AAF mechanics chosen to work on the original XP-59A jet plane while it was being put through months of tests in the California desert. After the project was revealed, he was sent to Wright Field to keep the planes in shape for training and further experiments.

"Every mechanic gets a funny feeling when he first sees the jet job," Kohler says. "I remember what I thought. I said to myself, 'Hell, this thing won't fly. There's not enough stuff.' But after the jet took off a few times, I began to get the idea."

Mechanics trained on Thunderbolts, Lightnings, Marauders, and Fortresses—any of our aircraft with conventional engines—have learned to think of power in terms of solid machinery, Kohler explains. In a conventional engine everything is solid and tight. Mechanics think in terms of complicated wiring, ignition, gauges and cylinders, elaborate fuel systems. Everything is complicated.

"But in the jet plane everything is simple," Kohler says. "You put in six quarts of oil, just like an automobile."

The cooling system is just a couple of oil jets which spray lubricant and air into the two rotor shaft bearings. The oil is standard hydraulic fluid 3580. The excess

runs down and forward into the accessory section, and is returned by a small scavenge pump. The system is cleaned by a Cuno filter. The generator, fuel pump, and starter are the only accessories carried over from the conventional plane, and the ignition is even more simple than the oil system. There are only two spark plugs, located in the No. 4 and No. 8 combustion chambers.

The other chambers are interconnected and ignite from these two. After the unit is started, combustion continues without further assistance from the plugs. Combustion is as steady as the flame of an oil furnace. Plugs last as long in the intense heat of the jet as they do in a conventional engine. In the jet their spark gap is considerably wider.

Kohler and his men work on the P-59A, which must be classed as a training plane in the jet field. Yet, with few exceptions, their experiences would be applicable to any jet aircraft.

"We use about a fifth as many tools," Kohler explains, "and maintenance of a jet plane is less than a fifth of what it is on the other kind. As for the engine, it's so damn simple I can't understand it."

"Air comes in the front end, goes through the compressors, *(Continued on page 224)*



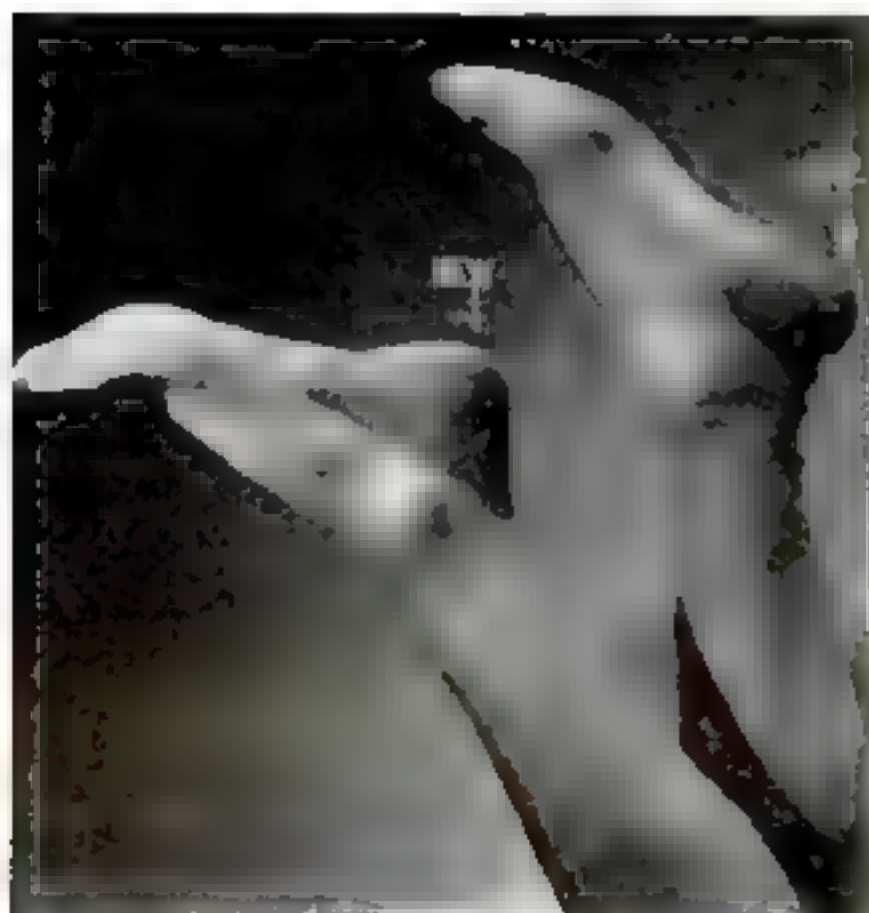
FABRICS

SHRINKAGE CONTROL of wool yarn is effected by a melamine resin trade-named Lanaset. The picture at left shows samples of processed and unprocessed yarn after severe test washing. Strands of the untreated yarn are practically fused together. Below is a pair of socks, one treated and its mate untreated, after two hours of washing with soap and soda.



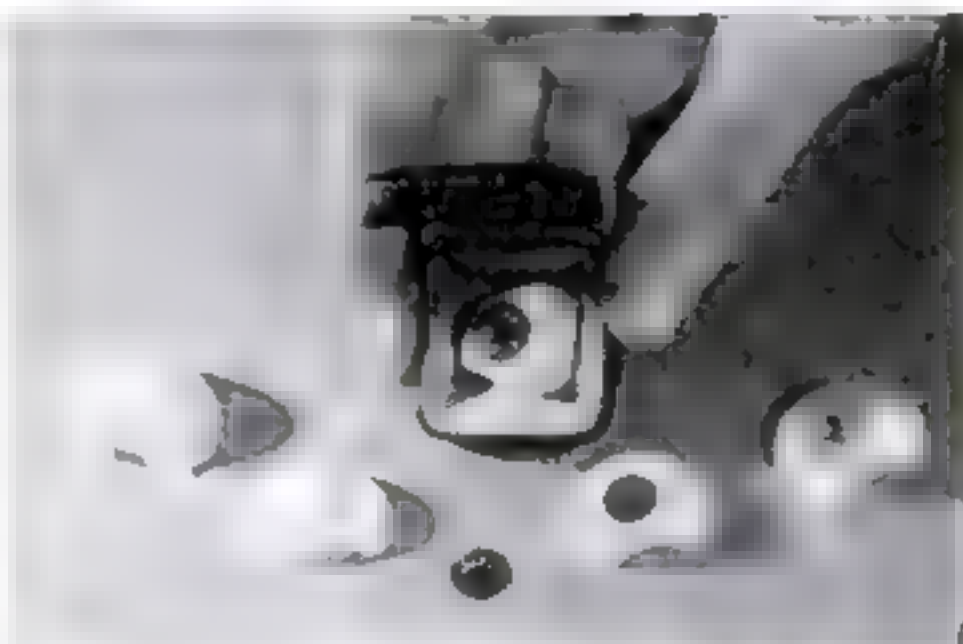
CLOTHING

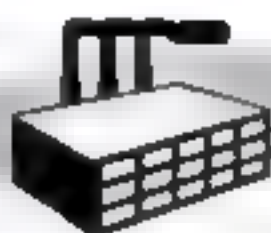
DESIGN FOR HEELS has recently been originated for use by the Gotham Hosiery Co. to make stockings fit better at this strategic point. Difference lies in the new heel's being knit at right angles to the leg, thereby preventing the wrinkles that may occur with the ordinary round heels.



OPTICS

PLASTIC EYES, made in the U. S. A., are now taking the place of the glass artificial eyes formerly imported from Germany. They are made of acrylic resin and, besides more closely resembling human eyes than do the glass substitutes, are practically unbreakable.



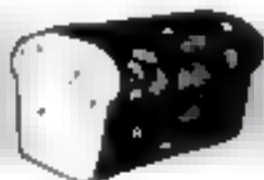


INDUSTRY

RUBBERIZING SHAFTS that drive warships of various types now guards them against pitting by electrolysis. Synthetic rubber can be applied by flame-spraying, as shown in the photograph above. Otherwise, a thin sheet of buna-S or GR-S is wound around the part normally exposed to salt water, wrapped with tape to hold the rubber against the metal, and vulcanized by a 24-hour steam bath. On wooden ships, unprotected steel shafts are attacked by electrolysis from bronze propellers.

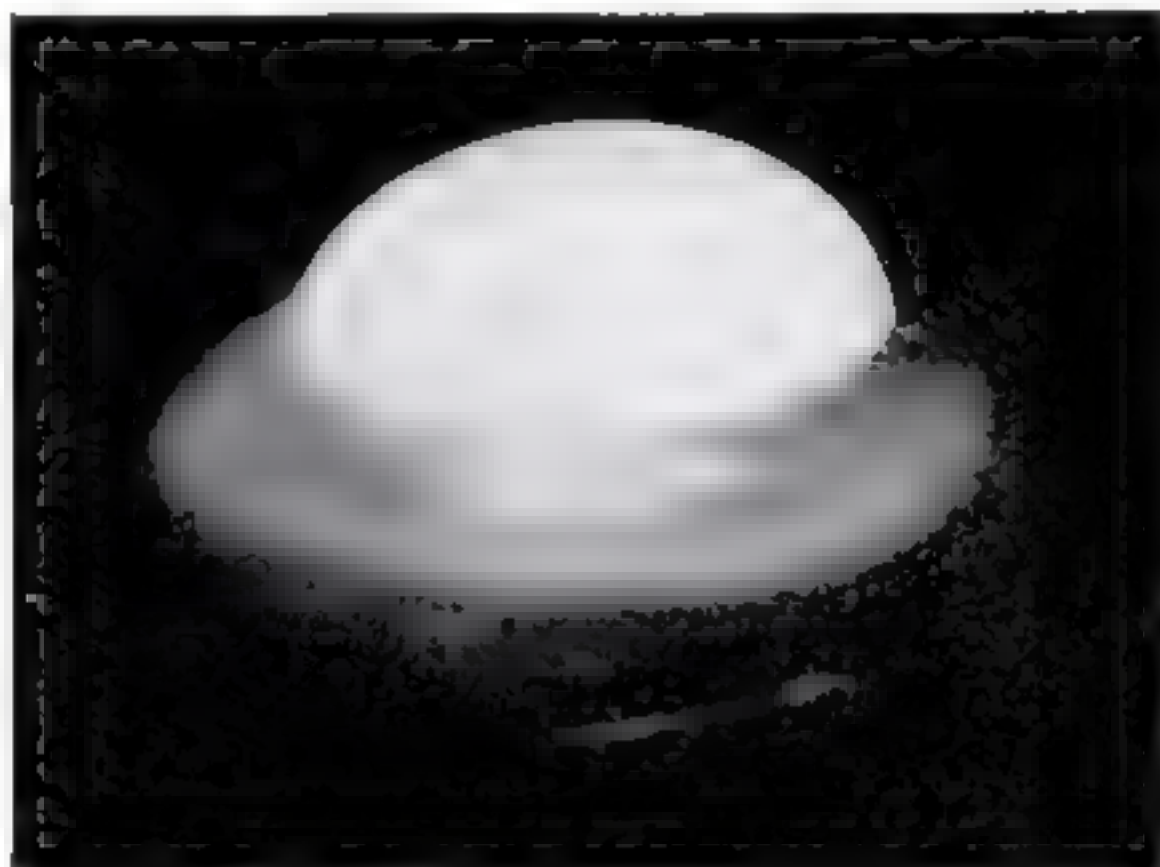


Propeller shafts are rubberized to prevent destructive electrolytic action. Upper picture shows flame-spray method of coating; below, beader rolls a vulcanized strip against shaft



FOOD

EGGS KEEP LONGER and look better when treated by a process called thermostabilization, devised at the University of Missouri. The eggs are immersed in liquids, with air circulating around them, and warmed to a relatively low temperature so that heat can penetrate the eggs before any part is coagulated. The process has not yet been adapted to commercial use. Picture shows egg held at 100 degrees F. for four days.





Piper Aircraft Corp.

This network of airways is the basis of the air tourist's map of tomorrow. Will your home town have an important place on it?

You Can't Fly Without Airfields

Will the Air Age be kept hovering while it waits for a place to land? We haven't nearly enough airports for our postwar plane traffic.

By

DEVON FRANCIS

THREE times in 150 years of United States history, transportation has been revolutionized. First came the development of canals and other inland waterways, then, the construction of our great railway network; finally, the building of an incomparable highway system. Each of these in turn brought profound changes in the American way of living.

Now we are at the beginning of a new era in transportation. We are ready to broaden and deepen the foundations for what may well become the world's finest

WILL YOUR TOWN BE ON THE AIR MAP?

GOOD ROADS made the Auto Age come true. Only good landing fields—and plenty of them, everywhere—will make the Air Age come true.

Go back a little—to 1920, just after the last war. We had 339,000 miles of surfaced streets, roads, and highways. On these we drove 9,000,000 motor vehicles. By 1941 we had spent over forty billion dollars for road building and had 1,697,000 miles of surfaced streets, roads, and highways. They carried 34,000,000 motor vehicles. And total travel was up 534 percent.

Landing fields are even more important to flying than good roads are to motoring. You can't fly anywhere unless you can land.

The extent to which you and your town are going to share in the benefits of the Air Age depends largely upon the personal interest that you and your fellow citizens take in providing adequate landing facilities—landing strips or flightstops, airparks, air harbors.

Almost everyone is going to fly—in private planes, in air taxis and air buses, in transports. A town with good landing facilities will grow with the Air Age . . . attract residents who are progressive, successful, forward-looking . . . gain the business advantages and added employment that go with the development of a gigantic new industry . . . expand its community activities. It will be tied into the whole world-wide postwar system of air transport.

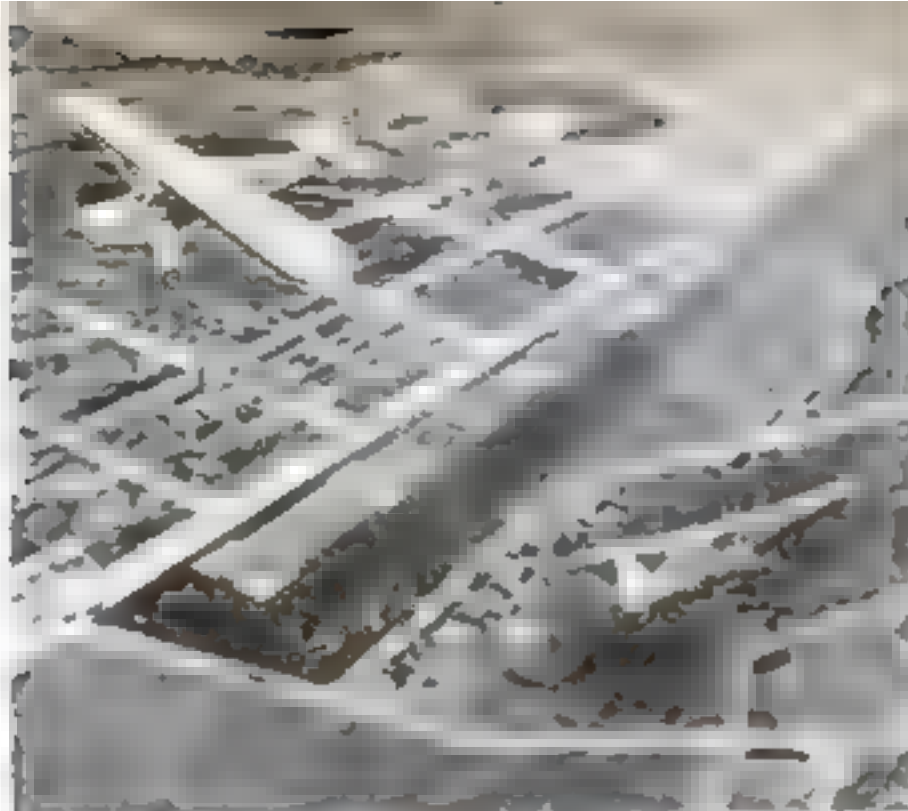
What finer tribute could any community make to the memory of the men and women who are sacrificing their lives in World War II than to build a victory landing field and dedicate it to them? It would be a living memorial, better than any monument.

To combat postwar unemployment, many states are already setting aside vast surplus funds for postwar improvements, part of which should be earmarked for landing fields. And the Federal Government, if it follows recommendations in the \$1,250,000,000 "National Airport Plan" of the Civil Aeronautics Administration, now before Congress, will share the costs with states on a 50-50 basis as in the Public Roads program.

Now is the time, therefore, to use your influence in your own community to plan a landing field and, if possible, acquire the land. Only in this way can you—and all your fellow citizens—share fully in the coming Air Age.

We should be glad to have your comments, suggestions, and questions on this subject. Address the Aviation Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y.

—THE EDITORS



SINGLE STRIP. Simplest of air facilities is a straight landing strip. All it needs is a sod surface running into prevailing winds, with sock and markers
Piper Aircraft Corp.



L-SHAPED STRIP is a natural expansion, allowing take-offs in four directions. Inexpensive hangar and fuel supply mark start of an airport

LANDING FACILITIES FOR PRIVATE FLYING MAY RANGE

facilities for travel in another medium—the air.

Both for the big commercial airliners, linking cities and continents, and for privately owned airplanes, giving personal wings to millions, airports, "airparks," and other types of landing areas will be built in each of the 48 states.

The bill: \$1,250,000,000.

The goal five or ten years from now: 6,000 landing areas, or one within reach of every American community with a population of 1,000 persons or more.

There is a close parallel between railroad and highway construction and the building of places where airplanes can take off and land. The major airport, with its multiple runways and instrument landing equipment,

A PROGRAM FOR POSTWAR EXPANSION OF LANDING FIELDS

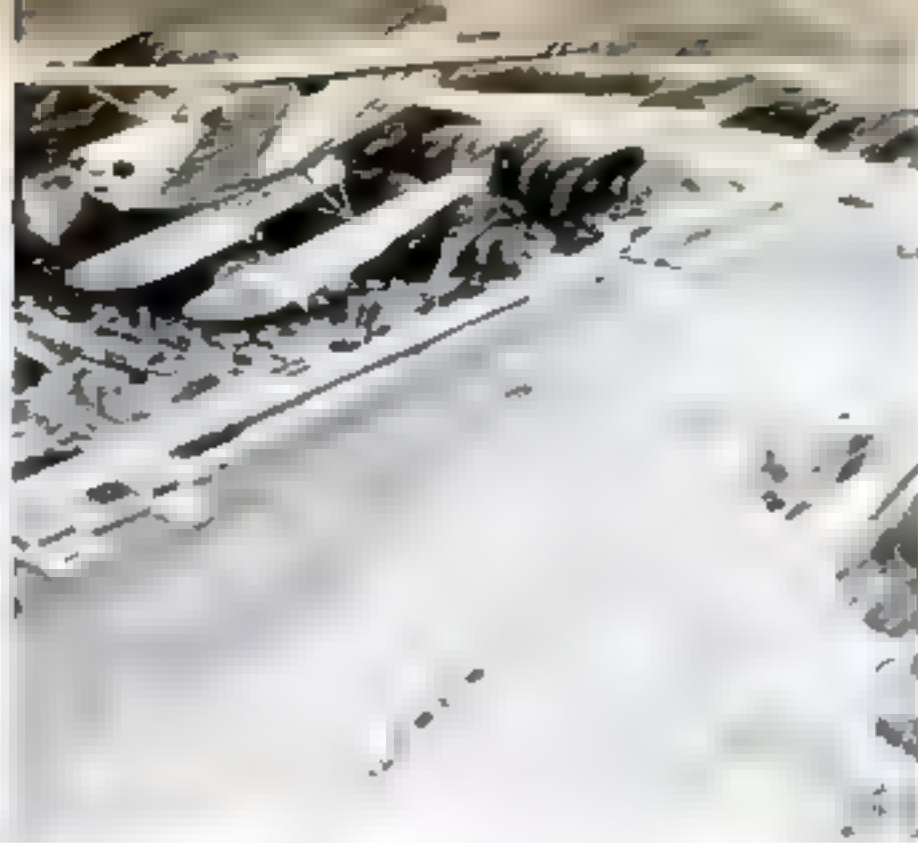


AT PRESENT there is, on the average, only one place in every 1,294 square miles where a private flyer can sit down. Even so, existing fields are bunched in thickly populated areas, so that there are vast areas with no landing spots at all



POSTWAR PLAN calls for a landing place within reach of every American community of 1 000 or more inhabitants, plus intermediate flightstops where private flyers can land in case of trouble





T-SHAPED STRIP offers the same advantages as the "L." Lay of the ground and other conditions will determine which is the better

AIR HARBOR. If the town is on a river or a lake, it can have a seaplane base. This can be combined with a landplane field for all-around service

FROM SINGLE FLIGHT STRIP TO FULLY EQUIPPED AIRPARK

AIRPARK. A park or fair grounds in or near the town makes a splendid location for an "airpark"—a combined landing field and recreation center. Such sites usually have good transportation facilities. Many communities will build airparks as memorials to the men who have served their country in the war



is to the transport plane what a track and a block-signal system is to the railroad train. The airpark and subsidiary landing facilities are to the private plane what the well-groomed highway is to the automobile.

The inland waterway was the backbone of the United States domestic transportation system in the first third of the nineteenth century. The golden age of railroad construction was the last half of that century. The extraordinary expansion of America's highway network occurred after the First World War.

Today the aviation counterpart of railroad and highway construction is a tele-

scoped project. Landing areas to give both the airliner and the personally owned plane maximum utility will be built simultaneously.

And, interestingly enough, just as the construction of railroads and highways had a pronounced effect on the ability of the nation to defend itself against attack, so will landing facilities for airplanes contribute to national defense.

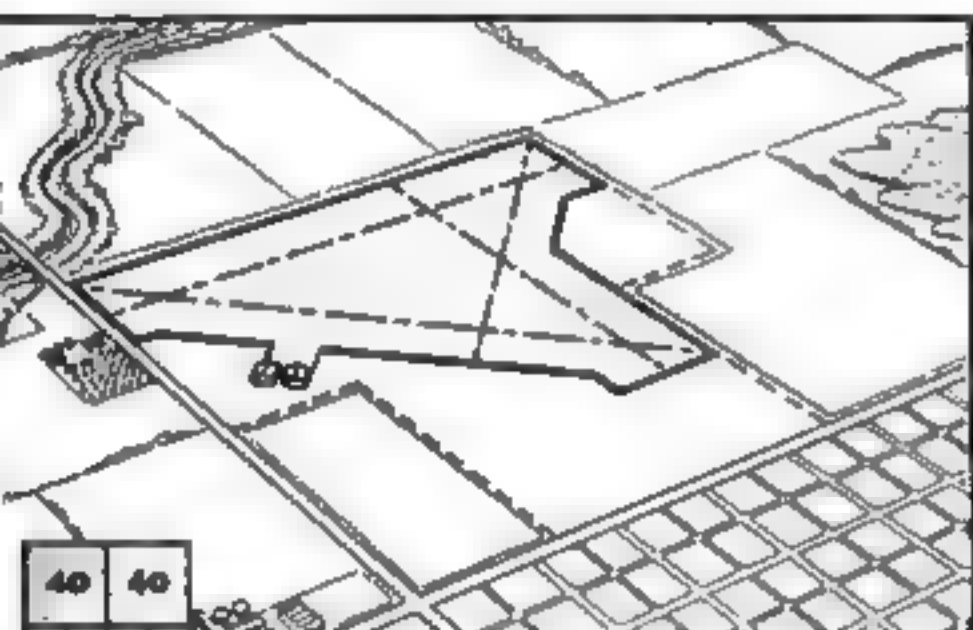
When the war is over we are going to need a lot of places where airplanes, of both the transport and personally-owned types, can take off and land.

Official Washington anticipates a twenty-

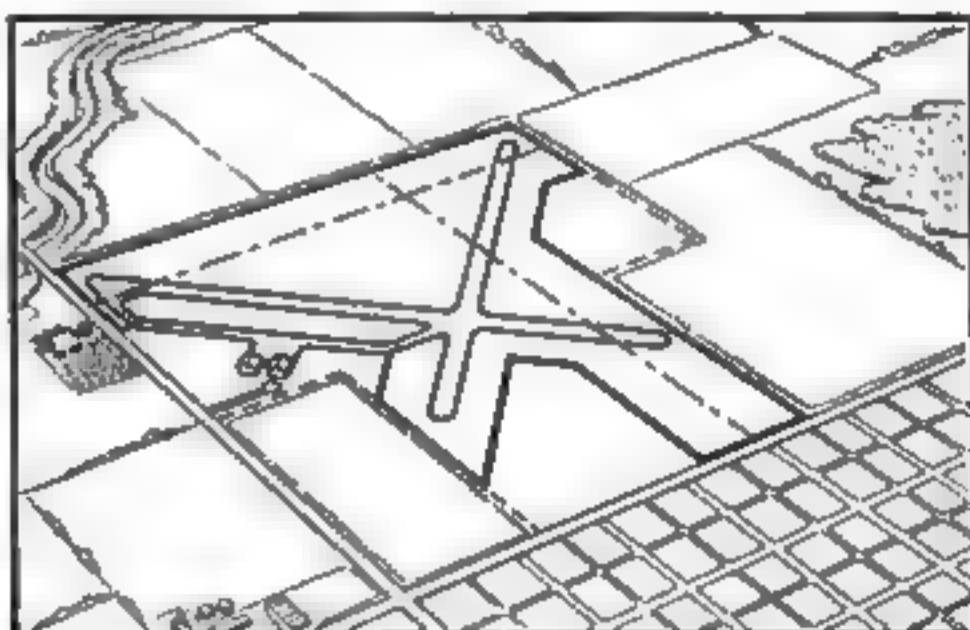
PLANNED AIRPORT CONSTRUCTION: HOW A CITY OF 5,000

HERE is the actual, move-by-move history of an airport planning program that is being carried out in a city of 5,000 inhabitants in western Michigan. Six sketches, redrawn by Stewart Rouse from "Michigan Airports," a

booklet prepared by the Michigan Board of Aeronautics, show the successive stages of construction to be undertaken as the growth of air traffic demands. The insets trace the acquisition of land, with the acreage of each plot.

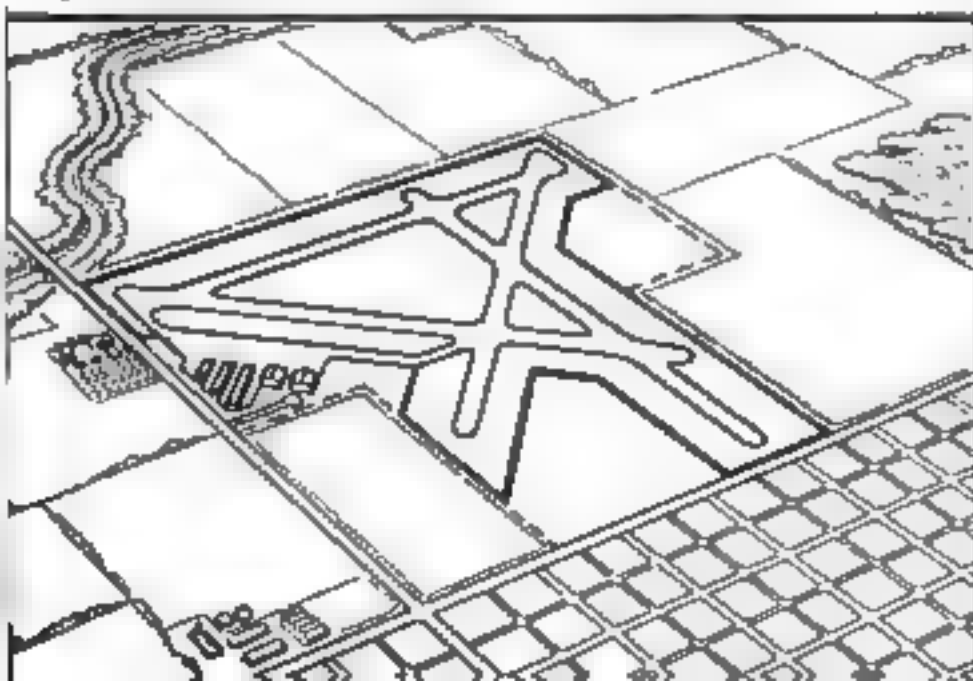


1 The site is a level, sandy plain. The approaches are clear and there is room for expansion. The original purchase covers 120 acres. Work in this first stage of development includes grading, draining, and seeding the landing strips

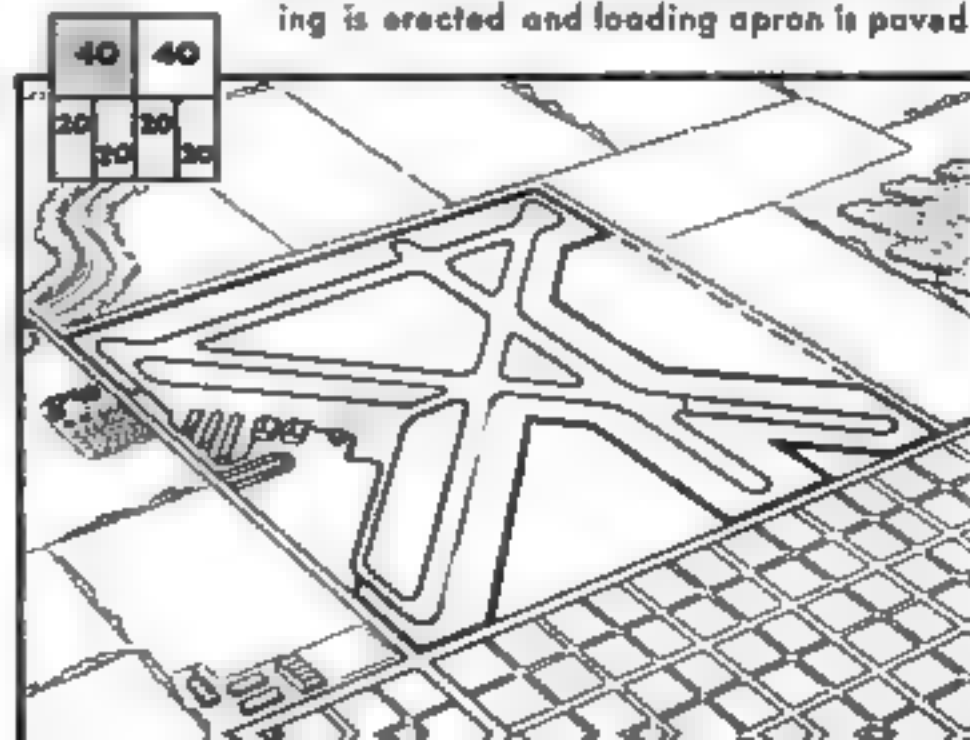


2 Here the landing strips have been extended to the maximum allowed by the size of the property, and two of them have been paved to 2,500 feet. A taxiway and apron have been provided. Note that all paving is planned to fit in with the later stages of development

3 Two more runways are paved to the CAA standard for "Class 2" airports, as shown by shaded portion of sketch. Inexpensive unit or "T" hangars are added as needed. Proper grading and draining of original landing strips makes later paving easy



4 An additional 40 acres of ground is acquired, and the two diagonal runways are extended to 3,500-foot, "Class 3," standard for limited air-line operation. First unit of administration building is erected and loading apron is paved



fold increase in the number of licensed airplanes by 1950. On the basis of less than 25,000 nonmilitary aircraft of record before Pearl Harbor, that would mean a half million private planes and commercial transports. Other estimates run well beyond the million mark for the end of the first decade after the war.

Today there are good landing facilities for only a fraction of either number.

We have, in fact, less than 3,000 fields, exclusive of those built for military operations. Of those, 740 are suitable for airliners.

Only 291 communities in the United States

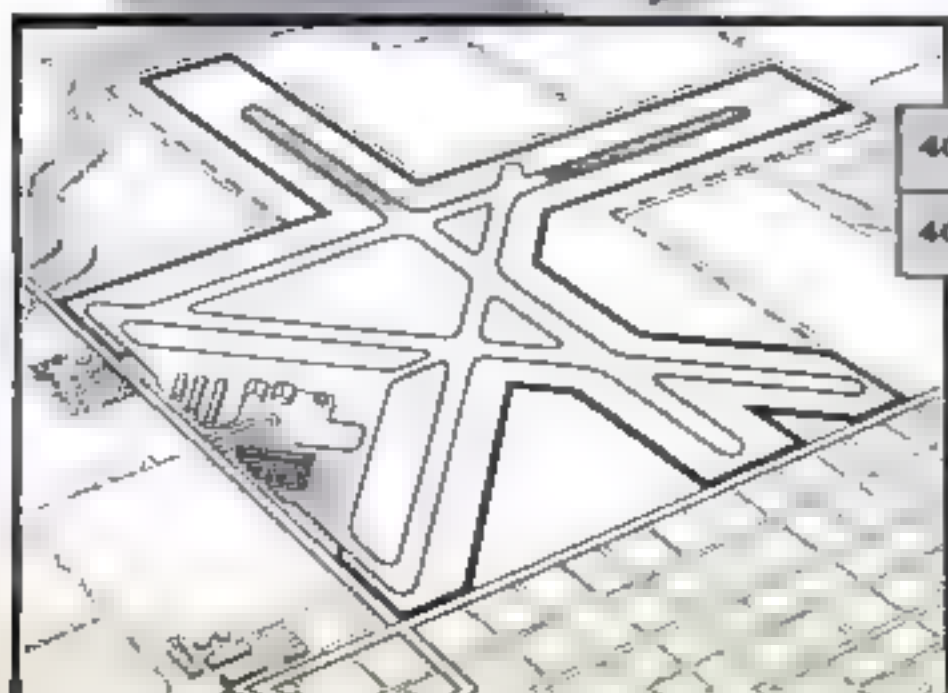
are served now by the scheduled air-transport system. Almost 6,500 with populations of 1,000 or more have no service.

Government experts estimate that within a decade after the war 20 million passengers will ride the air lines annually as against a fifth of that number in 1941.

The number of intercontinental commercial airliner flights will be increased sharply. Planes will leave not only from the seaboards but also from cities in the interior of the country. It is a shorter distance from Chicago to Moscow than it is from New York to Moscow, for instance.

In most parts of the United States the

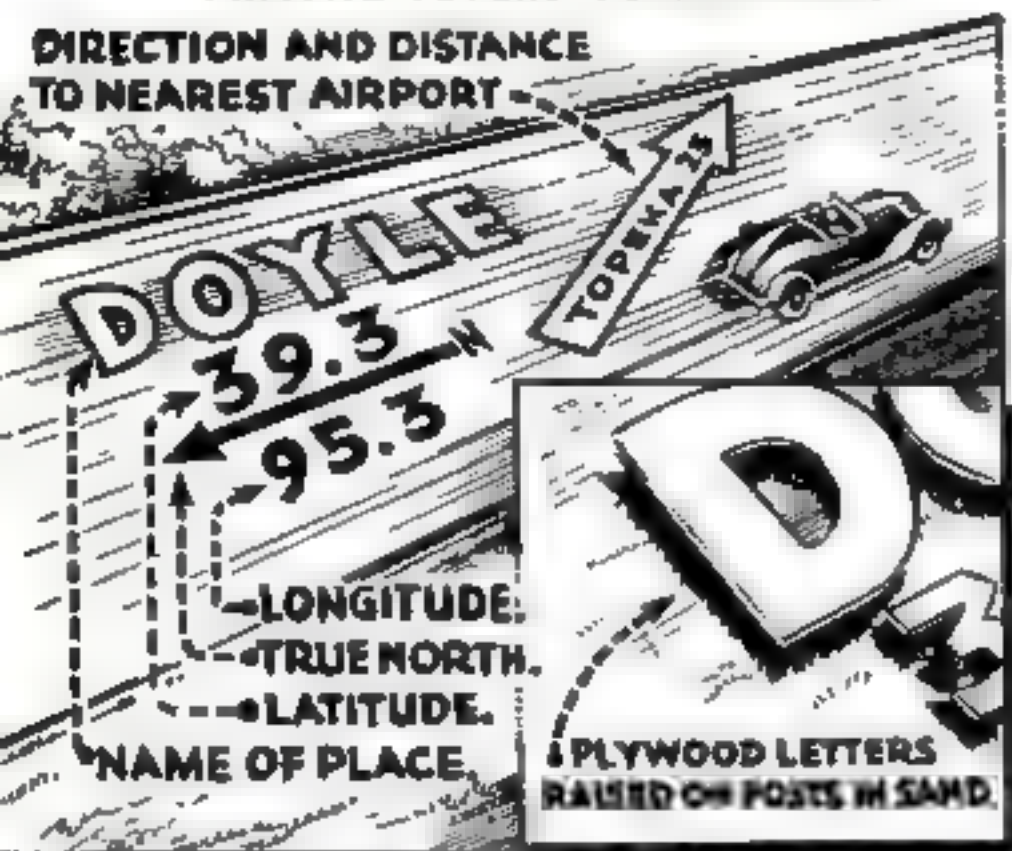
PLANS TO KEEP ABREAST OF ITS GROWING AIR NEEDS



6 Here the airport has reached the maximum development proposed for it. The runways have been widened to 150 feet; taxiways have been paved, administration building is enlarged; more hangars added.

5 Addition of 40 acres, bringing the total area to 200 acres, now makes it possible to extend the two shorter runways to "Class 3" standard of 3,500 feet. More individual hangars with paved aprons have been built.

**DIRECTION AND DISTANCE
TO NEAREST AIRPORT**



Under the CAA Air Address System, every city, town, and village in the United States eventually will be marked for identification from the air. Markings may be painted on highways or outlined in crushed stone, evergreens, or plywood

private pilot, riding cross-country, keeps a worried ear attuned to the throb of his engine and a bilious eye on the weather, because the spots where he can make emergency landings are few and far between. On the average, he has a place to sit down only once in every 1,294 square miles.

Even that figure is misleading, because landing fields are bunched around the more populous areas, leaving the great open spaces arid of facilities. Moreover, fully half the existing fields are indifferently maintained. In bad weather they are mud holes. They are badly marked. A pilot needs a telescope to spot them from the air.

We are going to have a lot more places where airplanes can take off and land. More than 60 percent of the money to be poured into standard airports and lesser landing facilities is earmarked tentatively for improving ports that can be used by airliners.

Here is a hypothetical case history of what expanded air-line service would mean: Two cities of 100,000 population lie 800 miles apart. Between them, evenly spaced, are five communities of 25,000 each. If a transport plane makes a stop at one of those five communities on its flights between the two big cities, traffic between the terminals increases by 70 percent. If two stops are made at intervals of 200 miles, the traffic increase is 160 percent. If stops are made at all the intermediate communities, the traffic between the two terminals increases sixfold.

The rest of the money earmarked for landing-field construction and improvement will go to the private flyer. Counting all the projects in the long-term plan, he will

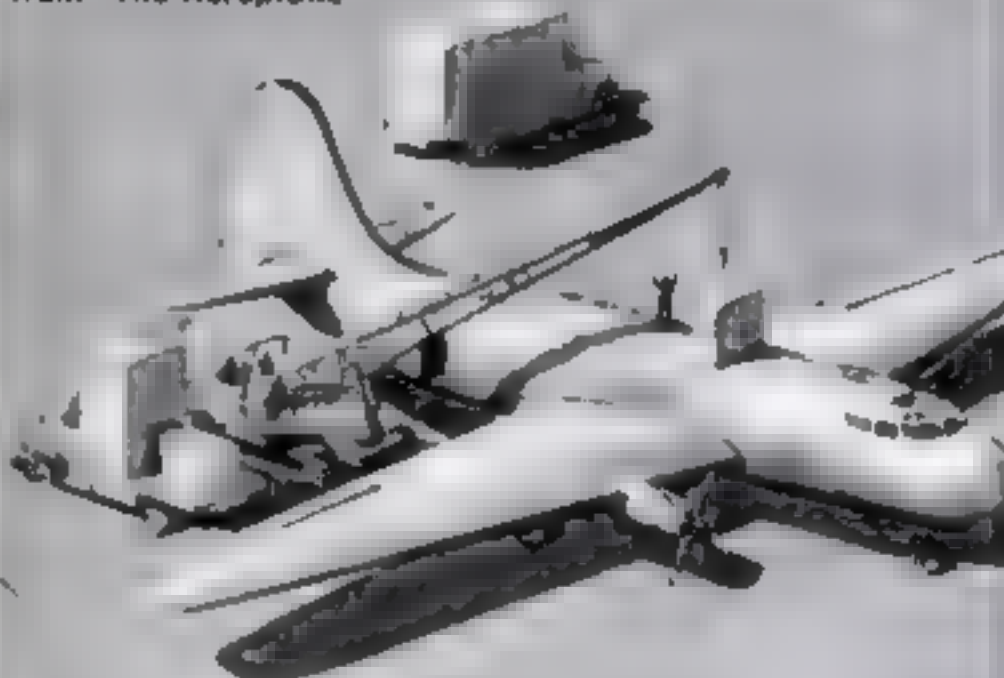
have a minimum of 5,000 ports. Possibly, with the inclusion of intermediate landing "strips," he will have as many as 8,000 to 10,000 stopping points. If he had 8,000, he would enjoy a landing area in every 372 square miles.

The nation's smaller communities will benefit most from the airport program. Of the new airports planned, only 150 will be built in cities of more than 50,000 population; only 59 in cities of between 25,000 and 50,000; but 515 in cities of 5,000 to 25,000, and 2,326 in towns of less than 5,000.

What neither industry nor Government knows is just what America will have when the building project is complete. Airplane design, as to both size and performance, which largely dictate airport design, is in a state of flux. The commercial air lines are only guessing about what kind of equipment they will need a decade, two decades from now. Manufacturers are only guessing about how many people will buy planes for their personal use.

INGENIOUS ACCESSORIES WILL

Redrawn by E. G. Seelstad
from "The Aeroplane"



COMPARTMENT LOADING, using containers that form sections of the fuselage, has been suggested for speeding the handling of cargo. Sections would be filled at freight terminals and brought by truck to the airport, where cranes would exchange them for the incoming containers.



CUSTOMS UNIT, with luggage conveyor and platform, is towed to meet arriving airliners.

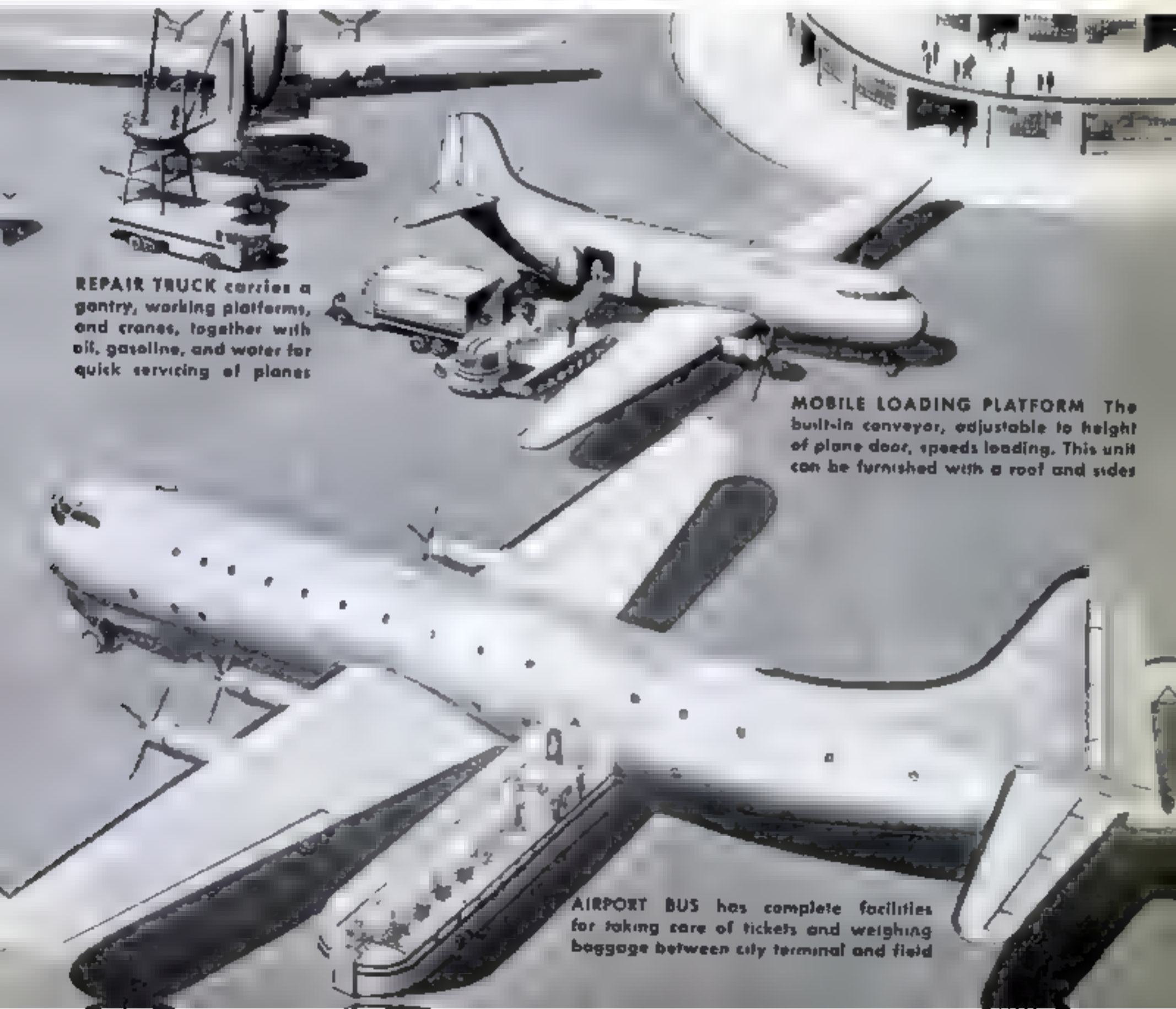
Will the transoceanic airliners be behemoths of 200 tons gross weight, as compared with today's 40-ton standard versions? Will the domestically used transports carry 30 passengers or 100, and on hops of what length? How many coast-to-coast nonstop or one-stop schedules will be needed as against "local" schedules stopping every 50 or 100 or 200 miles? Will the take-off and landing speeds of transport planes require surfaced runways a mile in length, or a mile and a half, or two miles?

Will private-owner aircraft be standardized in the conventional fixed-wing design, or will they be largely of the whirling-wing type like the helicopter and the Autogiro? If of the fixed-wing type, will better engineering progressively reduce their take-off and landing runs, *(Continued on page 211)*



POSTWAR COMMERCIAL AIRPORT. Facilities must be provided for handling the huge skyliners that will shuttle across the continent and the oceans. A fine example of progressive thinking in this field is the project of the Oklahoma City Chamber of Commerce pictured

SPEED THE DISPATCH OF PLANE PASSENGERS AND CARGO



REPAIR TRUCK carries a gantry, working platforms, and cranes, together with oil, gasoline, and water for quick servicing of planes

MOBILE LOADING PLATFORM The built-in conveyor, adjustable to height of plane door, speeds loading. This unit can be furnished with a roof and sides

AIRPORT BUS has complete facilities for taking care of tickets and weighing baggage between city terminal and field

Zoom Boats Sock Like Battleships

NAVY TELLS SECRETS OF ITS DEADLY ROCKETS

RANGE flames flash and smoke puffs along the decks as American landing craft approach hostile shores. But these jets of fire in the dawn's dim light cheer the men about to land, for they mark the departure of a salvo of rockets to clear the coast of Japs.

Each rocket whooshing forward will hit like a 105-millimeter shell, and hundreds of rockets now can be shot electrically from the tilted crates along the sides of a single landing craft. All told, the short-range salvos from one rocket-firing craft may be a fourth greater than the firepower of two of our modern, *New Jersey* class, 45,000-ton battleships.

Rockets are an ancient weapon; they stopped Kublai Khan in the thirteenth century. But they have been improved so greatly so recently that the Navy spent 10 times as many million dollars to produce them in 1944 as in 1943. And now, more huge rocket factories are being built—to supply the armed forces with more millions of dollars' worth of rockets per month this year than were ever made before per year.

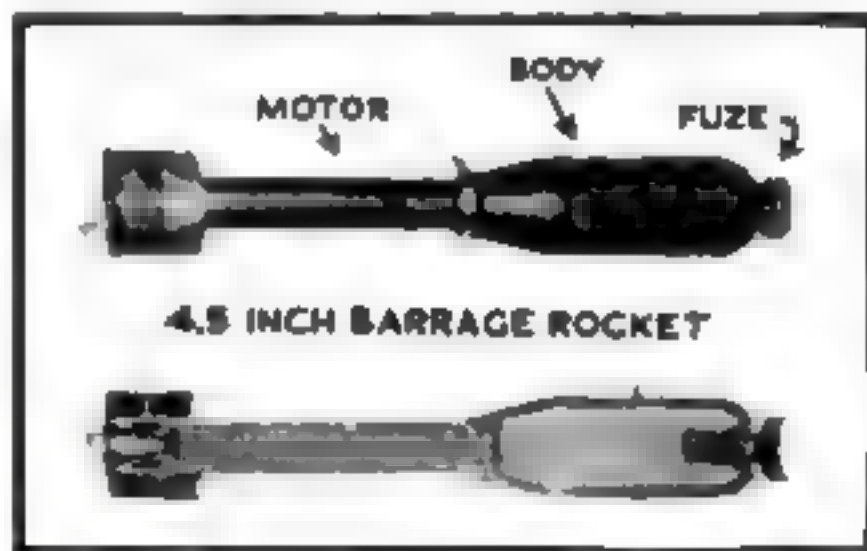
The beach-barrage rocket that is clearing the way for American invaders in the Pacific weighs a little more than 15 pounds. Its body is 4.5 inches in diameter and is loaded with a high explosive. On its nose there is a tiny wheel that is whirled by the wind when the rocket swishes into the air. This arms the fuse, which touches off the explosive payload in the body of the rocket

when it strikes upon the enemy's ramparts.

Behind the explosive head of the projectile is a "motor" consisting of a long, narrow tube of propellant powder and an electrical wiring system. Current to start this motor is supplied by batteries, charged by generators fed by the ship's engines. Contact between these batteries and the wiring within the rocket is made by a little wire, known as a pigtail, which extends from the rocket's tail into the launching rack.

When current flows into the wiring system through the pigtail, the propellant powder is ignited at the end near the payload. The fire travels backwards through this tube of powder. It burns more slowly and steadily than ordinary gunpowder and emits fiery gases. These escape through a nozzle in the tail and thus drive the rocket forward.

There is a loud hiss, rather than a boom, when a rocket is fired. The tail jet is so



Portable rocket-launching racks set up on this LCVP give the tiny landing craft the firepower of a big warship. Light and easily handled, they save American lives in landing operations

Rocket "gunners" wear asbestos suits and gas masks for protection against flaming gases and fumes of tail jets





Rocket racks on an LCI. Projectiles are carried in banks of ten and fired electrically. Rockets in the bottom row of each rack are fired as a salvo. As each whooshes out, another slips down in rack to replace it.

Clearing the road to Tokyo, a rocket-firing LCI lets fly with a barrage to smother Japanese defenses on a Philippine beach as the first wave of amphibious troops nears the shore. Rockets hit like 105-mm. shells.





GERMAN ROCKET GUN fires one of its six projectiles at Allied troops. Our Navy's work at Inyokern is designed to keep us abreast of any foreign developments in war and peace

Rockets streak from launching racks mounted on a jeep at the Naval Ordnance Test Station, Inyokern, Calif. Here over a 1,025-square-mile tract of lava mountains fringing the Mojave Desert, the Navy tests rockets designed to be fired from ships, planes, and land installations. The driver of the jeep sits between two racks

Below, projectiles are being loaded aboard the firing platform set on the back of a quarter-ton. The jeep carries the rockets to selected firing points, from which they are launched at targets in the desert while observers take movies of their flight. Plane-carried rockets are photographed from accompanying aircraft

but that men take cover before launching these rockets and wear asbestos suits when working with them. But this bright, yellowish, torchlike flame lasts only long enough to lift the rocket well into the air. It ceases before the projectile begins its descent toward the target

The effect on the enemy is similar to that of heavy mortar fire. Rockets do not have the velocity or high degree of accuracy of artillery. But *Continued on page 232*





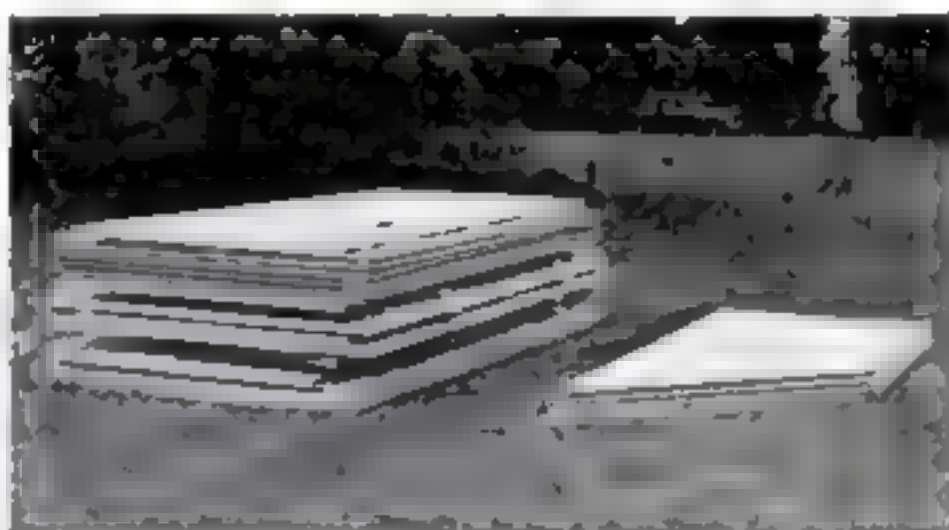
This paper house to accommodate four people costs about \$50 for materials and can be erected in about 59 minutes by two men. It is designed for an emergency shelter in case of bombing, flood, or other disaster.

Paper House Costs \$50

BUILDING a home out of paper in 59 minutes may be the answer to housing problems created by fire, flood, or other disasters. Two workmen recently did the trick with materials that had been developed for a four-season test by the Institute of Paper Chemistry, Appleton, Wis.

The basic material is chipboard consisting entirely of fibers from news, wrapping, and other waste papers. The board is treated with a fortifying agent that, according to tests, has made it resistant to "creep" even under tropical weather conditions. In addition to this, the panel material is protected against water by a resistant paint that also contains a fireproofing agent.

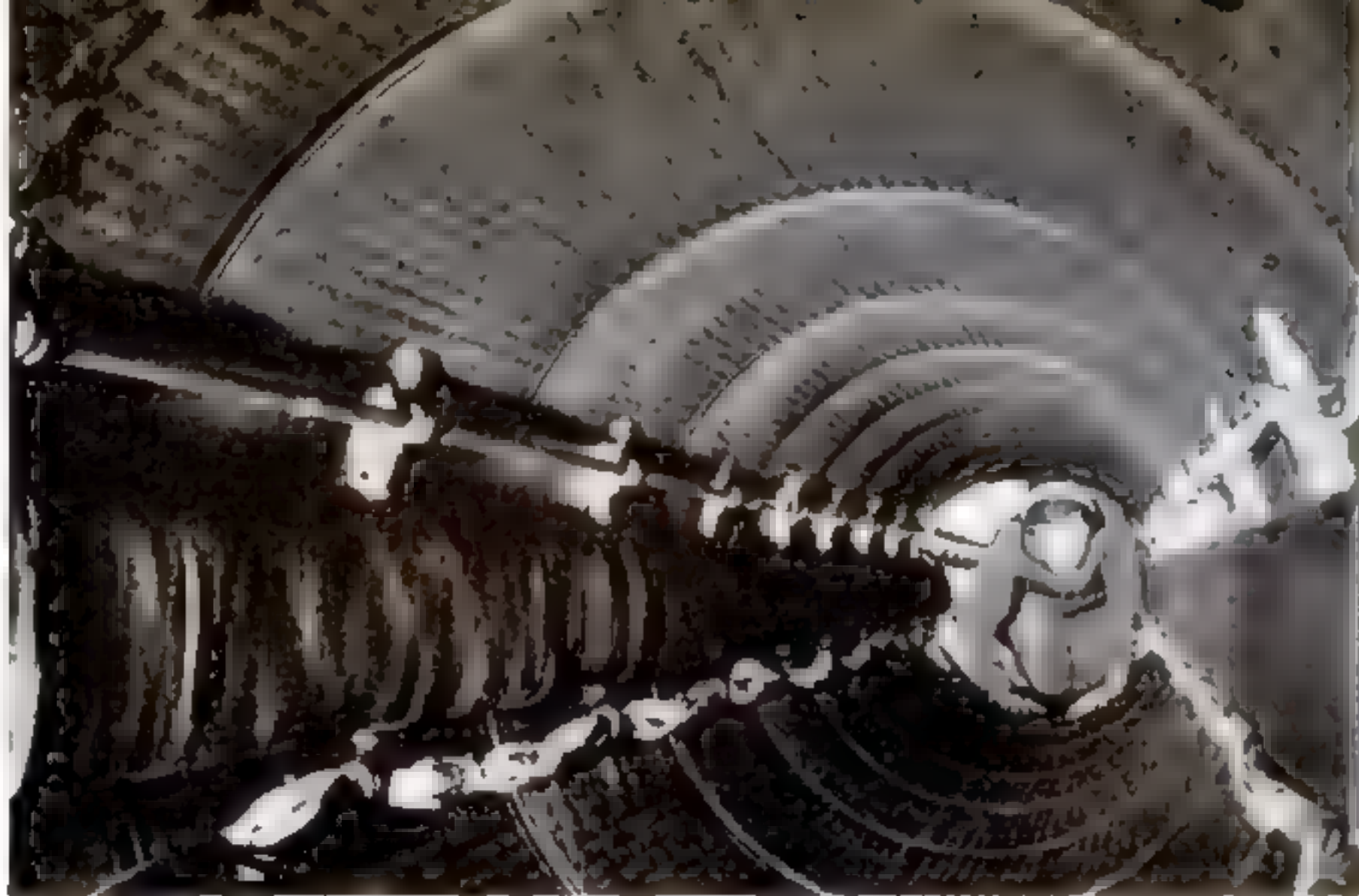
The house has a floor space of about eight by 16 feet. No framing or studing is used, but the panels are securely joined by a system of metal connectors. Joints in the roof members are sealed against moisture with waterproof paper tape. With two double-deck bunks, the house could shelter a family of four. The total cost of materials for the unfurnished house is slightly more than \$50.



Sections of the paper house ready for assembly. Except for hardware and plastic windows, the structure is entirely of material developed from a base of waste paper.



Here 10 of the 21 panels shown above are in place. Stringers supporting floor panels need not be used where site is leveled, but sills are laid under edges.



TUNNEL connects the pressurized gunners' compartment with the control cabin. Here a crew member starts the 35-foot crawl forward. Tunnel passes over the unpressurized bomb bays

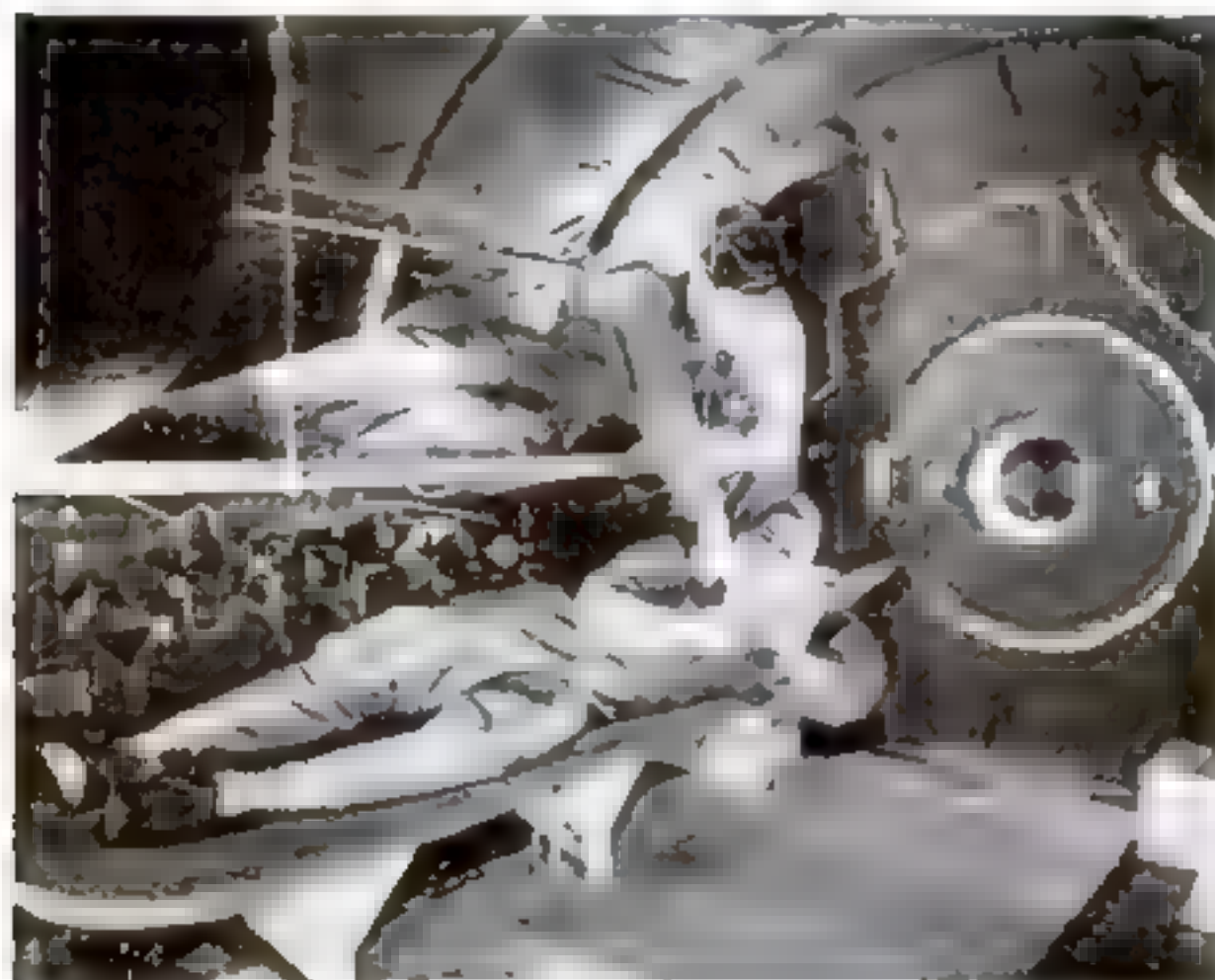
Let's Look Inside a B-29

EVER wonder what it's like inside the big belly of the Boeing B-29 Superfortress? All right, come along. We'll go through one from nose to tail.

Up in the tip of the long nose, where the bombardier sits between the feet of the pilot and copilot, you have the feeling that

you are riding on the tip of a spear hurled through space. Back-to-back with the co-pilot rides the flight engineer with his panel of dials and indicators; behind the pilot, the navigator sits at his big table. On the other side of the fuselage, beyond the bowl of the forward top turret, is the post of the radio man.

From this pressurized control cabin you crawl aft through a 35-foot padded and heated tunnel that passes over the bomb bays to a second pressurized compartment where the gunners rule. From a rotating pedestal "throne" in the center, the fire-control gunner looks out over the top of the fuselage from a transparent blister. Below him, on either side, sit the waist gunners in



CREWMEN REST on long missions in a compartment aft of the gunners' section. At upper left is the top rear turret. Beyond bulkhead at rear is the storage space in tail



COPILOT'S SEAT is abreast of the pilot's. Their instrument panel is fairly simple, as many dials and indicators are on the board of the flight engineer, back-to-back with the copilot

BOMBARDIER'S "OFFICE" in one of the newest Superfortresses is inspected by Lt. Edwin G. Lagasse, of Schenectady, N. Y., veteran of two raids on Japan in the B-29 "Mysterious Mistress"



the bulging side blisters. Each of these three has a sight with which to operate the remote-control turrets.

Next you come to the crew compartment, where relief crews can relax on long missions. Bunks, food, and first-aid supplies are tucked into every corner not occupied by other equipment.

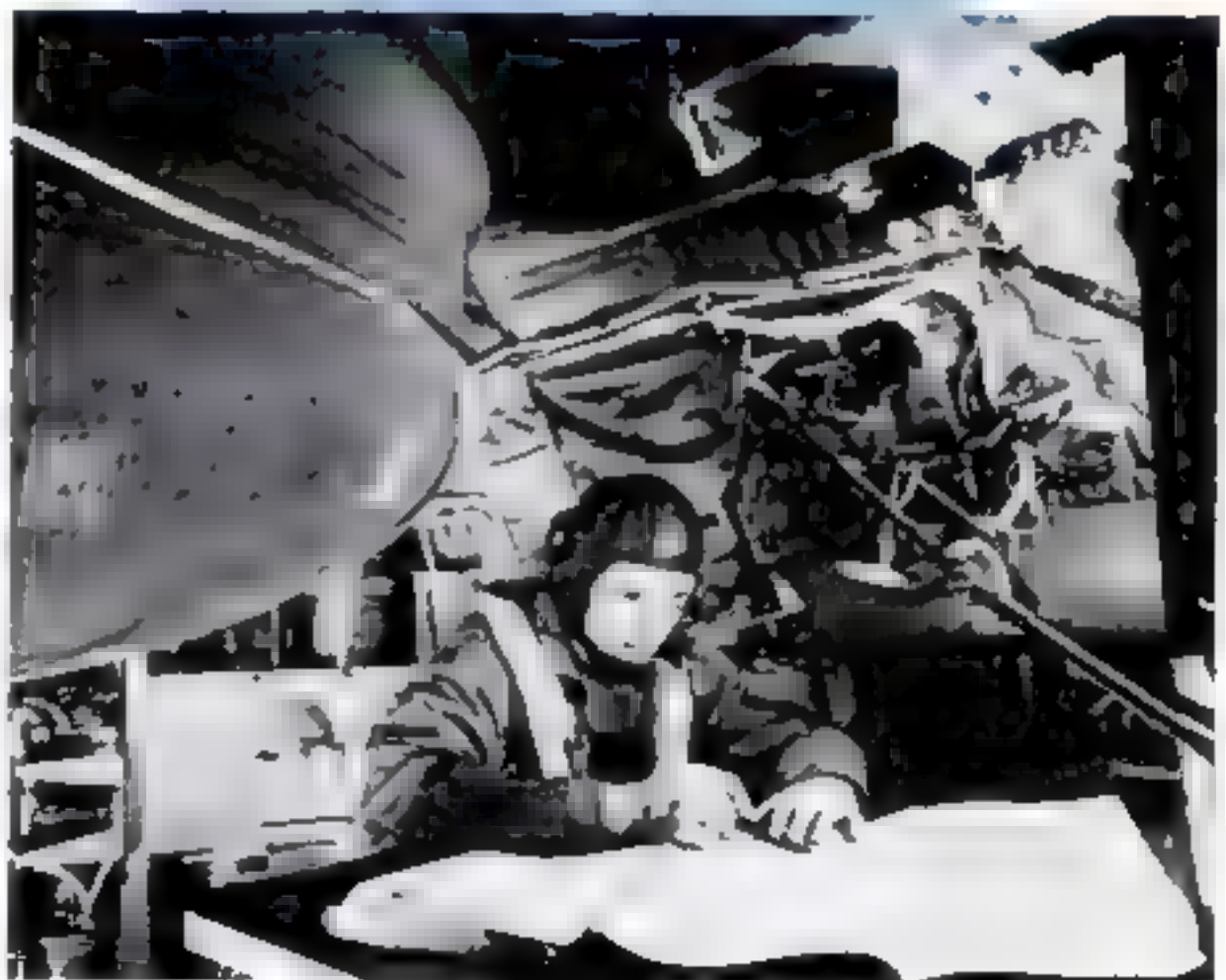
Now, through a pressure-lock door, you enter the unpressurized storage space aft. This is filled with auxiliary equipment, the retracted emergency tail wheel, and other things over which you pick your way down the narrowing fuselage to the tail.

Through another pressure-lock door you squirm into the end-of-the-world station of the tail gunner. It is surprisingly roomy. You can stand erect or climb into the tail gunner's seat behind the twin .50 caliber machine guns and the 20-mm. cannon. He looks out through heavy, bullet-resisting glass. With his own pressurizing unit and interphone, he is cozy

and keeps in contact with his fellow crew

One thing that strikes you is that the B-29 is designed not only for efficiency as a fighting machine but also for the comfort of its crew. All pressurized sections are lined with a heavy heat- and sound-insulating blanket of dark-green quilted material. Heating pipes mingle with the maze of interphone and power wires. Seats are the last word in comfort. The plane is roomy and quiet—an airman's airplane.

NAVIGATOR plots a course at a large table on the port side of the fuselage, behind the pilot. A large case holds his maps. At upper left is a part of the forward top turret





FLAME-THROWING TANK. Darting a tongue of flame far ahead, this U. S. tank routs enemy troops from pillboxes, haystacks, and other hiding places. Mounting flame-throwing equipment in armored ve-

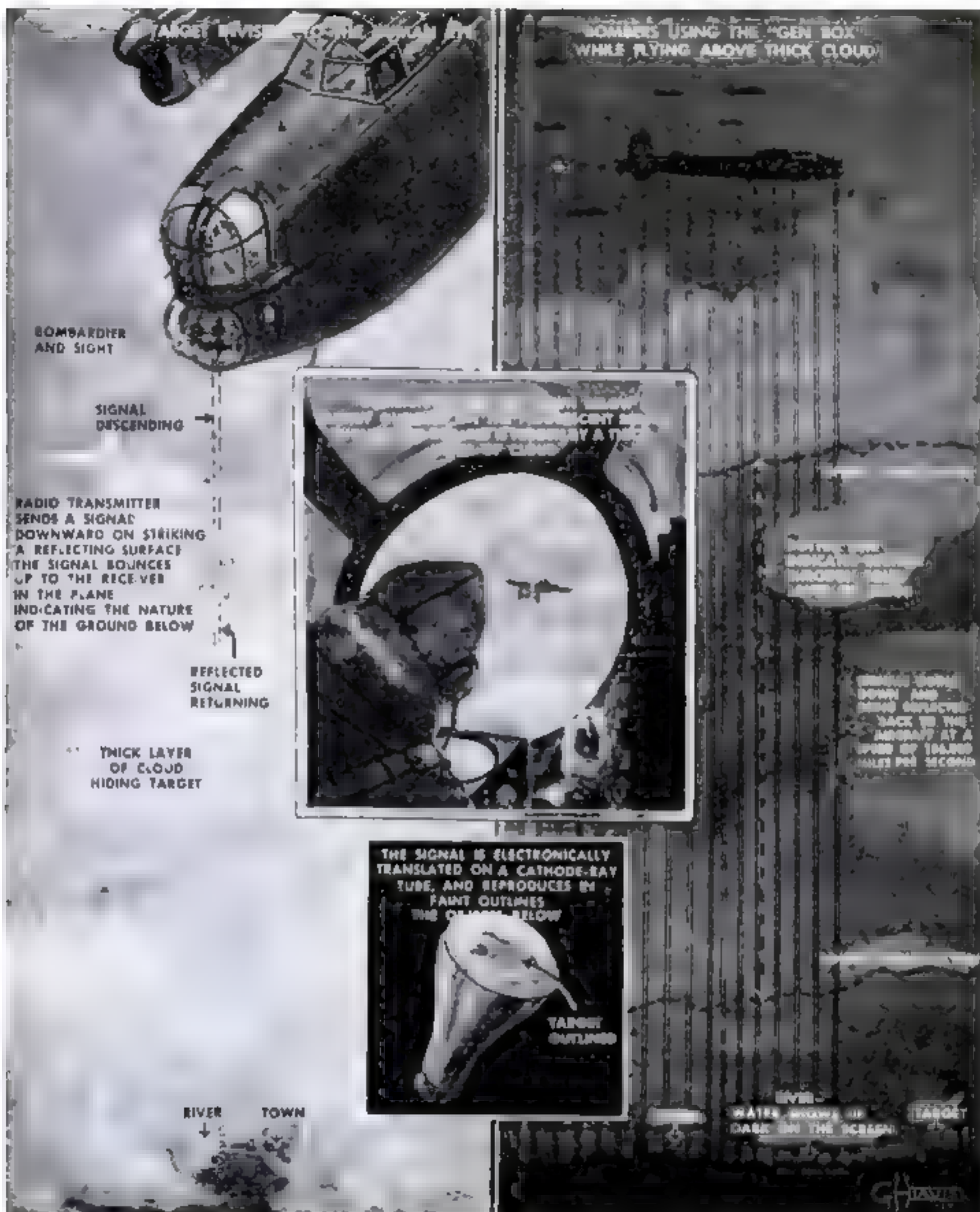
hicles makes it possible to carry this devastating weapon close up to positions that could not be approached by men in the open. Tanks so equipped were used with telling effect on the borders of Germany.

FLOATING REPAIR BASES, such as the auxiliary repair dry dock below, are one reason why our Navy has been able to strike at the very heart of Japan's stolen empire. This odd craft can submerge enough

to scoop up a destroyer through the gate seen in the stern. It then pumps itself dry, cradling the warship for repairs below the water line. Such floating dry docks follow the fleet to newly won island bases.

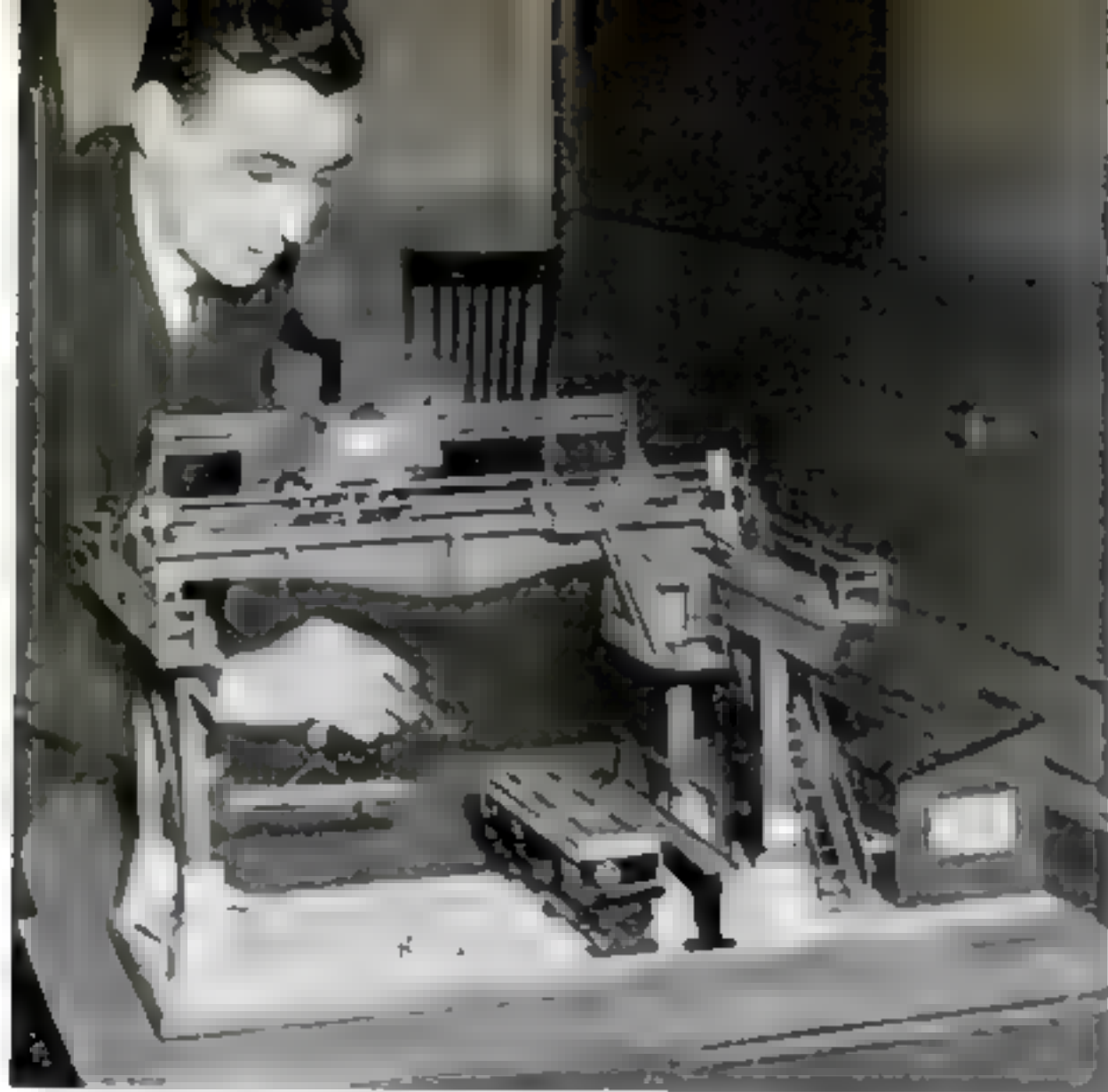


How We Bomb Through Clouds



LAYERS of thick cloud no longer shield enemy industrial centers and other objectives from the devastating attacks of Allied bombers. While it has been known for some time that our planes could strike invisible targets, details of the amazing invention that makes it possible have just been made public in this drawing by G. H. Davis for *The Illustrated London News*. Known to the British as the "gen-box" or "black

box," the device resembles in principle the "echo sounder" used on ships. A radio transmitter sends signals downward to the earth. Bouncing back to the plane, these are translated into a faint outline of the terrain below on the fluorescent screen of a cathode-ray tube. Water shows up as dark patches, while buildings, ships, and other solid objects are indicated as lighter patches with the same outlines as if viewed directly.



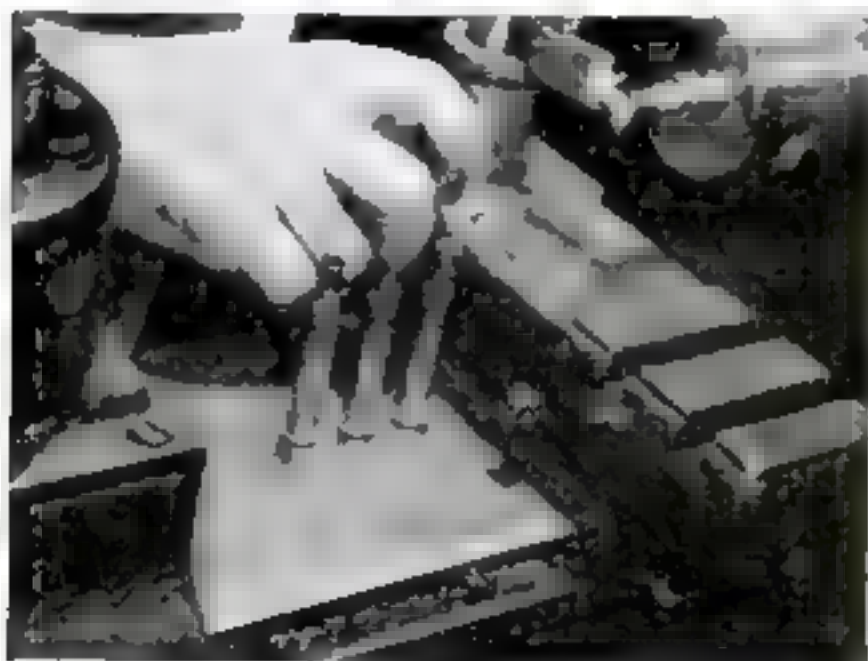
MODELS FOR SAFETY instruction, made by Richard V. Milligan, have been used by the Carnegie-Illinois Steel Corp. to teach safe job routines to employees. One of the models is of an overhead crane (left) complete to every moving part and safety feature. The model was made from a collection of 50 tin cans, watch parts, wheels from a toy train, flashlight bulbs, locket chains, and nail polish. A small electric motor supplies power to operate the crane. Milligan's work, including experiments with alloy metals for the crane's tiny parts, covered a period of six months, during which he spent a total of 300 hours' working time.

HE SAVED 11 MILLION CASES for rifle and machine-gun cartridges. Fred Masotta (left), of the Winchester Repeating Arms Co., devised a method of shaving over-long

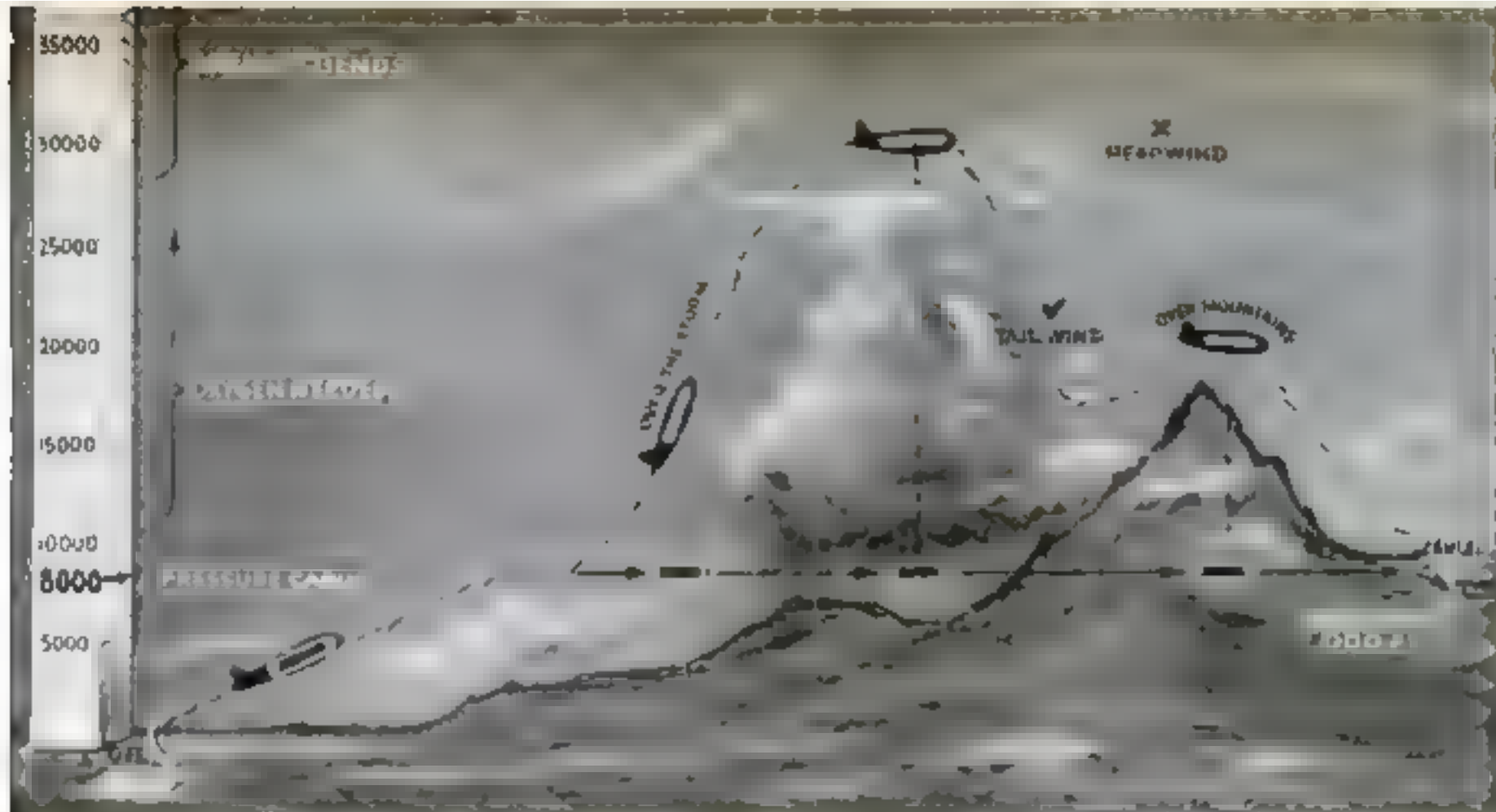
necks of military cartridges softened by annealing. With a special cutting tool (below) Masotta was able to salvage not only the 11 million cases, but, in addition, 26,500 man-hours of work, and to save over 440 million operations. He was twice awarded War Production certificates and has been otherwise cited for his ideas.



Watch is wound by rubbing the stem on a strip of fabric-backed Compor plastic mounted on a paddle, or fastened to the surface of the workbench



WINDING WATCHES can be a finger-cramping job, if you do it all day long. So watch testers at the U. S. Naval Observatory and in manufacturing plants grasp the watch and rub the stem on a strip of Compar, a vinyl resin derivative, fastened to a paddle or to the workbench.



Postwar airliners will be able to climb to 25,000 or 30,000 feet to fly over storms, catch favoring tail winds, and cross mountains without exposing their passengers to the discomforts of high altitudes.

Why Pressure-Cabin Transports?

Their purpose is not to permit stratosphere flying, but to let the plane seek its best operating level.

By ERIC SLOANE

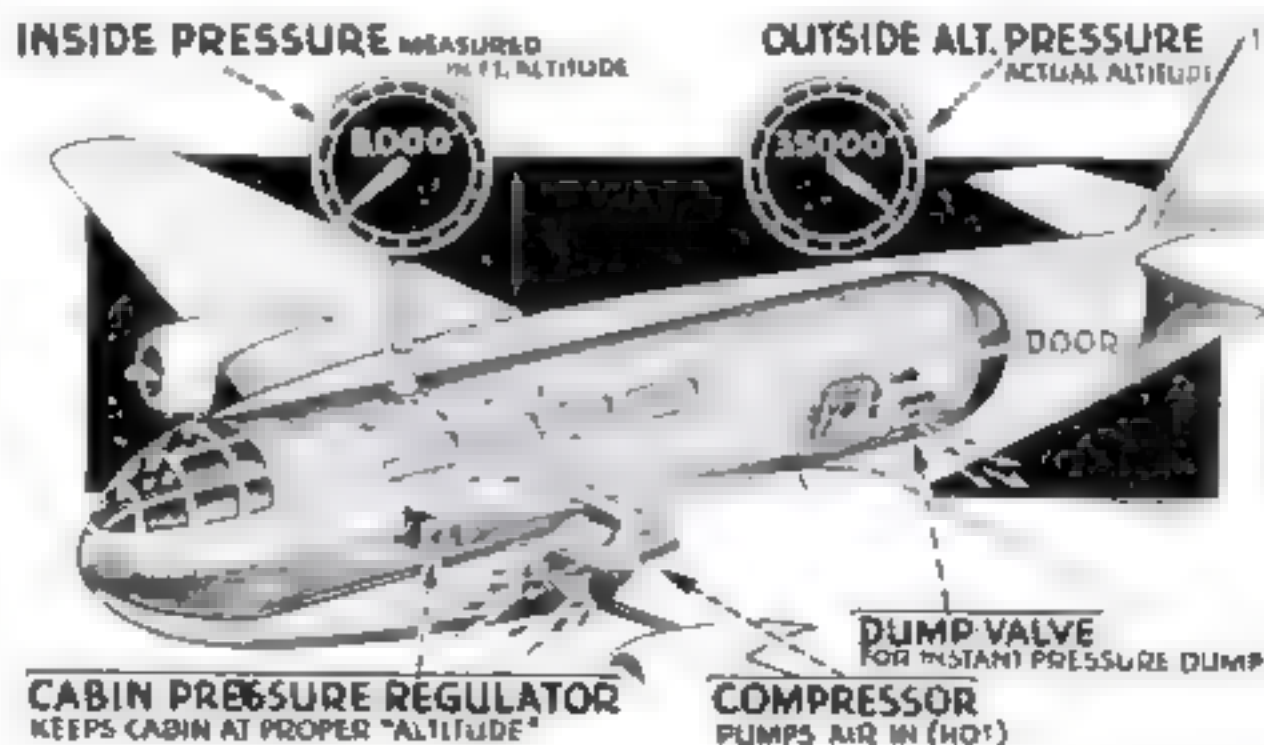
IF ANYONE should ask you why the big transport planes being planned for postwar global air routes are to have pressurized cabins, you would probably say that it is because they will fly in the stratosphere at altitudes from 40,000 to 50,000 feet. But that is not the real reason. There is no necessity for transports to fly that high.

What the sealed cabin will do is maintain a constant comfortable pressure corresponding to, let us say, an altitude of from 5,000 to 8,000 feet. Yet the plane will be free to rise to 25,000 or 30,000 feet as necessary to obtain conditions favorable to the safest,

Whatever the altitude at which the airplane is flying, pressure inside the cabin will be kept automatically at a level that is equivalent to about 8,000 feet

speediest, and most economical operation.

Passengers no longer will have their ears pain from altitude changes. There will be no danger from lack of oxygen, no discomfort from cold, no gas pains caused by reduced air pressure, and no chance of suffering the agony of aeroembolism, or "bends." (P.S.M., Oct. '43, p. 60.) It is because of these advantages that tomorrow's huge airlines will be equipped with pressurized cabins.





Cylinders of scrap magnesium, each with a six-foot return-current wire, are buried alongside iron pipe lines to counteract currents that cause rust

Corrosion has eaten away all but $\frac{1}{16}$ inch of the $\frac{1}{4}$ -inch wall thickness of this steel pipe. Straightedge reveals pitted surface

RUST PROTECTION for buried iron pipe is a new job found for magnesium by The Dow Chemical Co., Midland, Mich. Corrosion of iron underground is caused largely by galvanic currents set up by the interaction of impurities in the iron and chemicals in the soil. Corroding sections act like the anode, or positive pole, in a galvanic cell, and iron ions are carried away by the current as shown in Fig. A. These combine with oxygen to form iron oxide, or rust. To counteract this, 14-pound cylinders cast of scrap magnesium are buried near the iron pipe and connected to it by wire. Having a higher potential than iron, the magnesium sets up a countercurrent flowing into the pipe and thus removes the cause of corrosion.

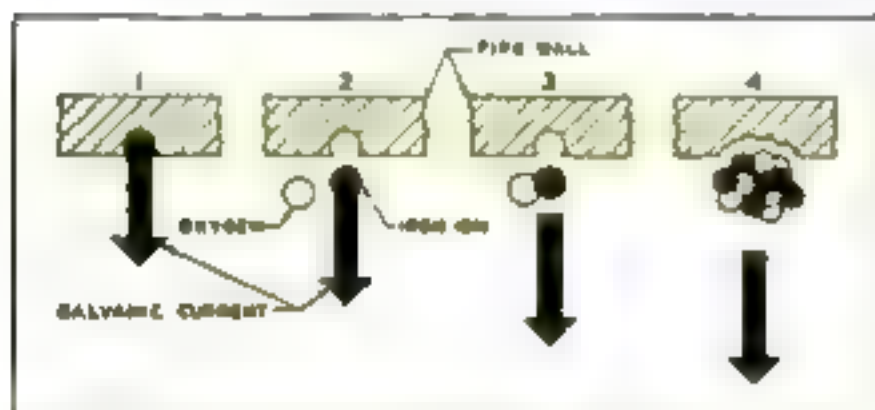


FIG. A

In unprotected pipe, corroding sections act like anodes of a galvanic cell, sending out current to carry off iron ions that are oxidized into rust

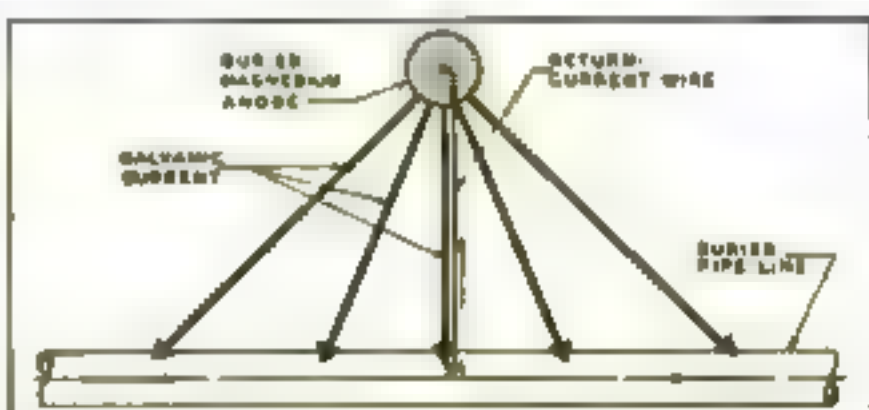
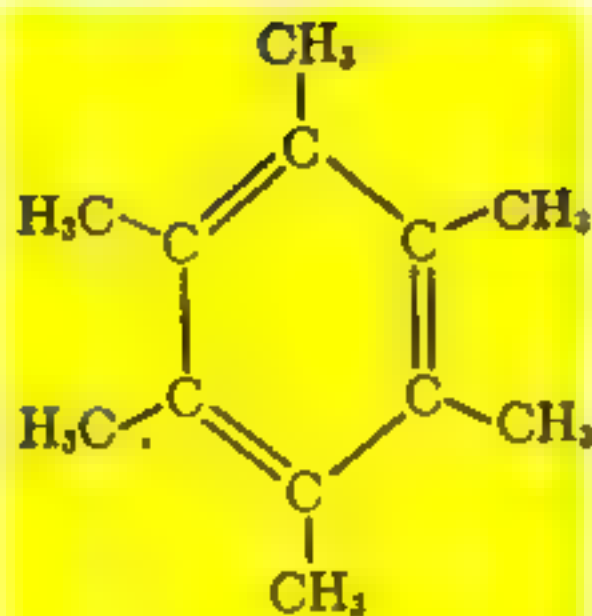


FIG. B

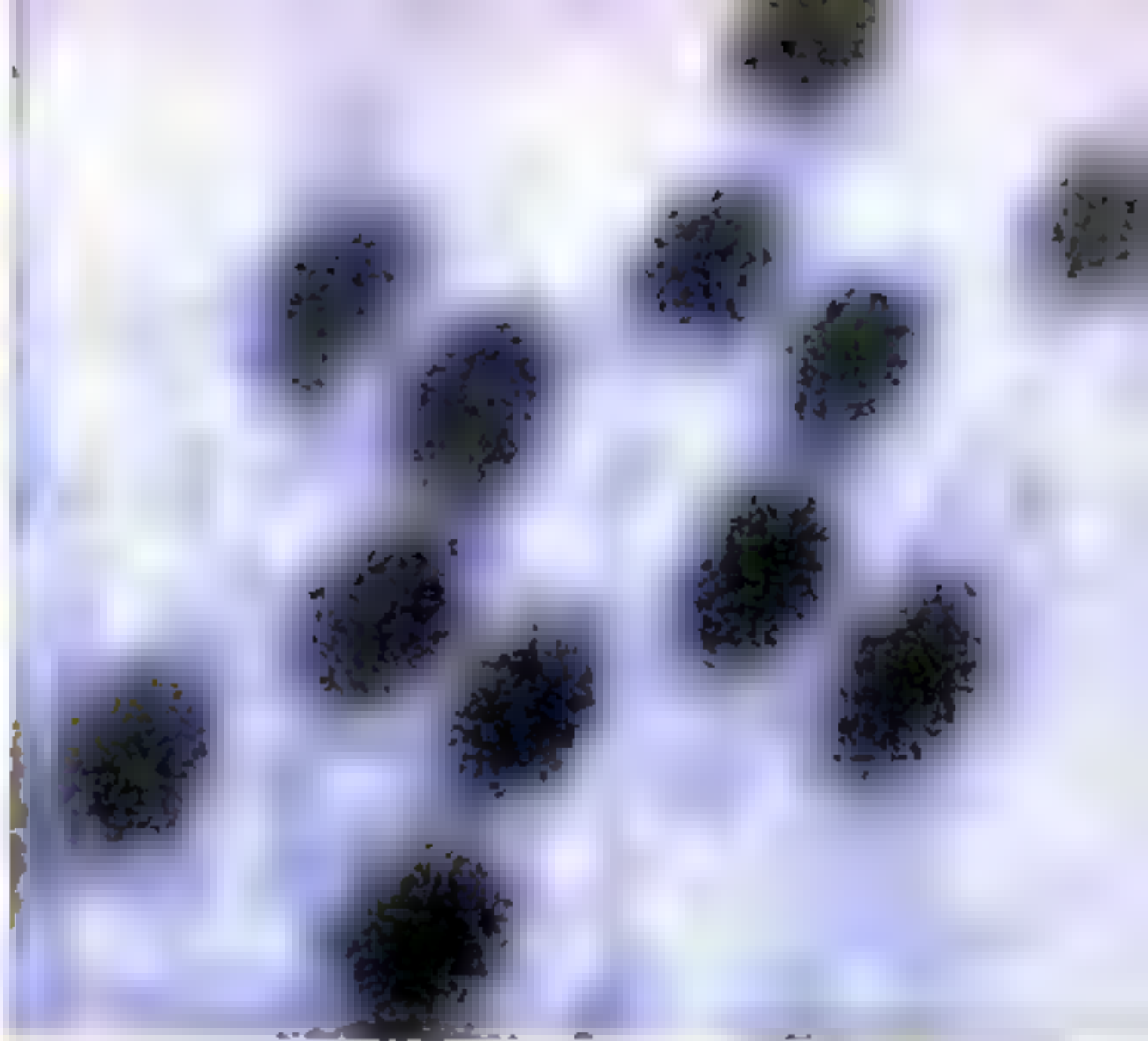
A magnesium cylinder buried near by becomes an anode itself, setting up a stronger current than the one coming from the iron and so halting corrosion



ARMADILLO is the name given by the British to this armored vehicle that they adapted from a delivery truck for use in protecting airfields in the event of enemy landings during the Dunkirk period. The tanklike defense wagon, was made by workers in the shops of the London Midland and Scottish Railway. L.M.S. shops also have turned out planes, bridges and armored trains for Britain's war effort.



BENZENE RING, represented by a hexagonal structure of six carbon atoms in the chemist's diagram of hexylmethylbenzene above, actually looks that way in the X-ray photo of a molecule of the compound, reproduced at the right



Ever See a Molecule? HERE'S ONE MAGNIFIED 200,000,000 TIMES

FOR many years, chemistry students have taken the word of their instructors that the "benzene ring"—a hexagonal structure of six carbon atoms—forms the nucleus of a great class of organic compounds. Now, for the first time, they may see the real thing. By developing a method of X-ray procedure first proposed by Sir Lawrence Bragg, the famed British physicist, Eastman Kodak Company technicians succeeded in filming the key-stone of these chemicals.

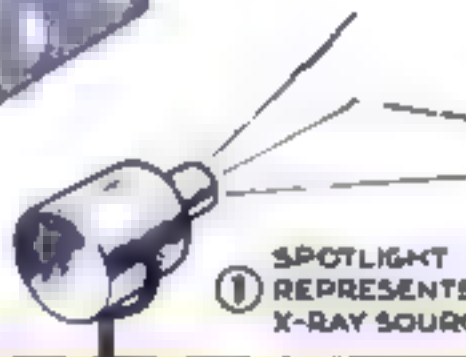
The remarkable picture above shows a molecule of a compound called hexylmethylbenzene, magnified about 200,000,000 diameters. Strikingly clear, the pattern of carbon atoms composing the benzene ring appears at the center. Surrounding carbon atoms may also be seen. To each of the latter are linked three hydrogen atoms, too faintly recorded to be visible, in what are known as methyl groups.

HOW PHOTO WAS MADE

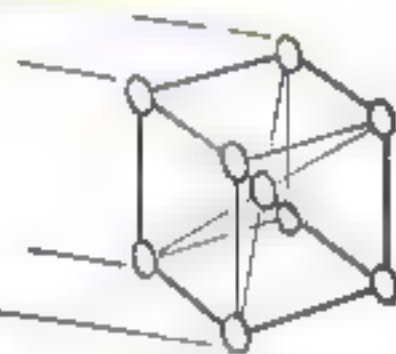
A rough mechanical analogy illustrates the process of atom photography. Light represents X rays; mirrors, the atoms of the latticework that forms a crystal of the substance; a screen, X-ray film that records image



① SCREEN REPRESENTS X-RAY FILM



① SPOTLIGHT REPRESENTS X-RAY SOURCE

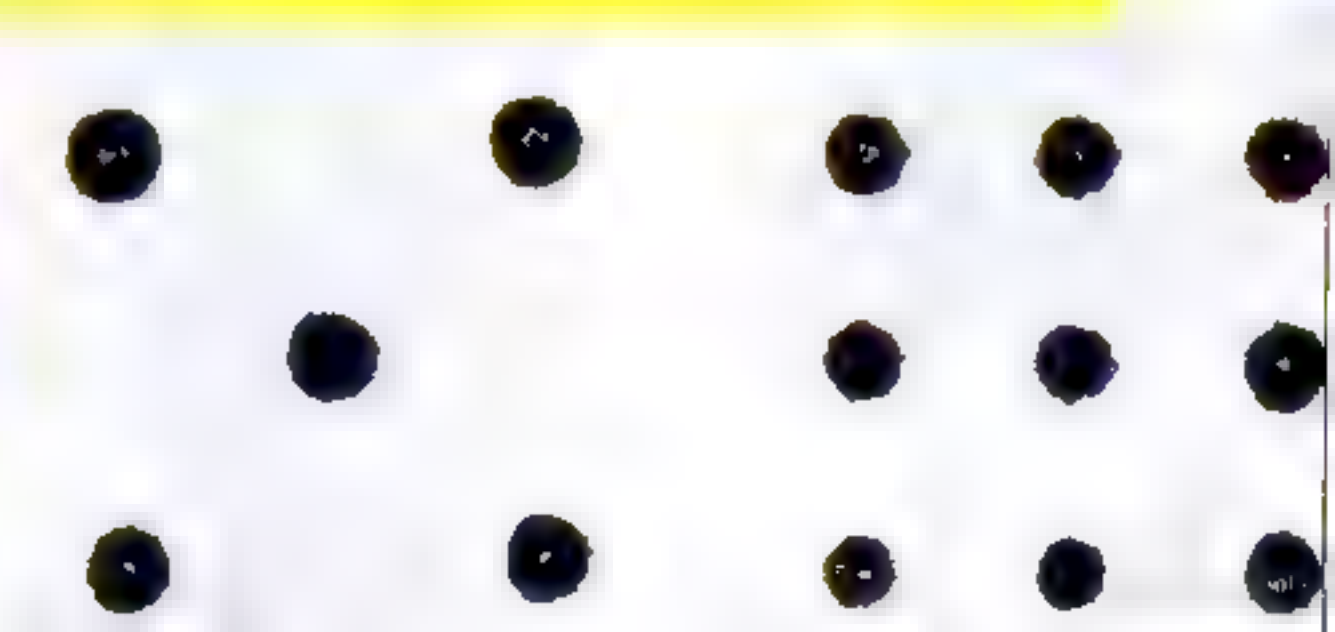


② MIRRORS REPRESENT ATOMS IN STRUCTURAL MODE

IRON. Distribution of atoms in the units of structure of iron, shown in the drawing, is revealed by the photo below at a magnification of 150,000,000. This arrangement is called a body-centered cubic structure



ALUMINUM presents a face-centered cubic structure. (Photo is magnified 100,000,000 times.) By this technique, atomic arrangements in metals, alloys and oxides can be analyzed

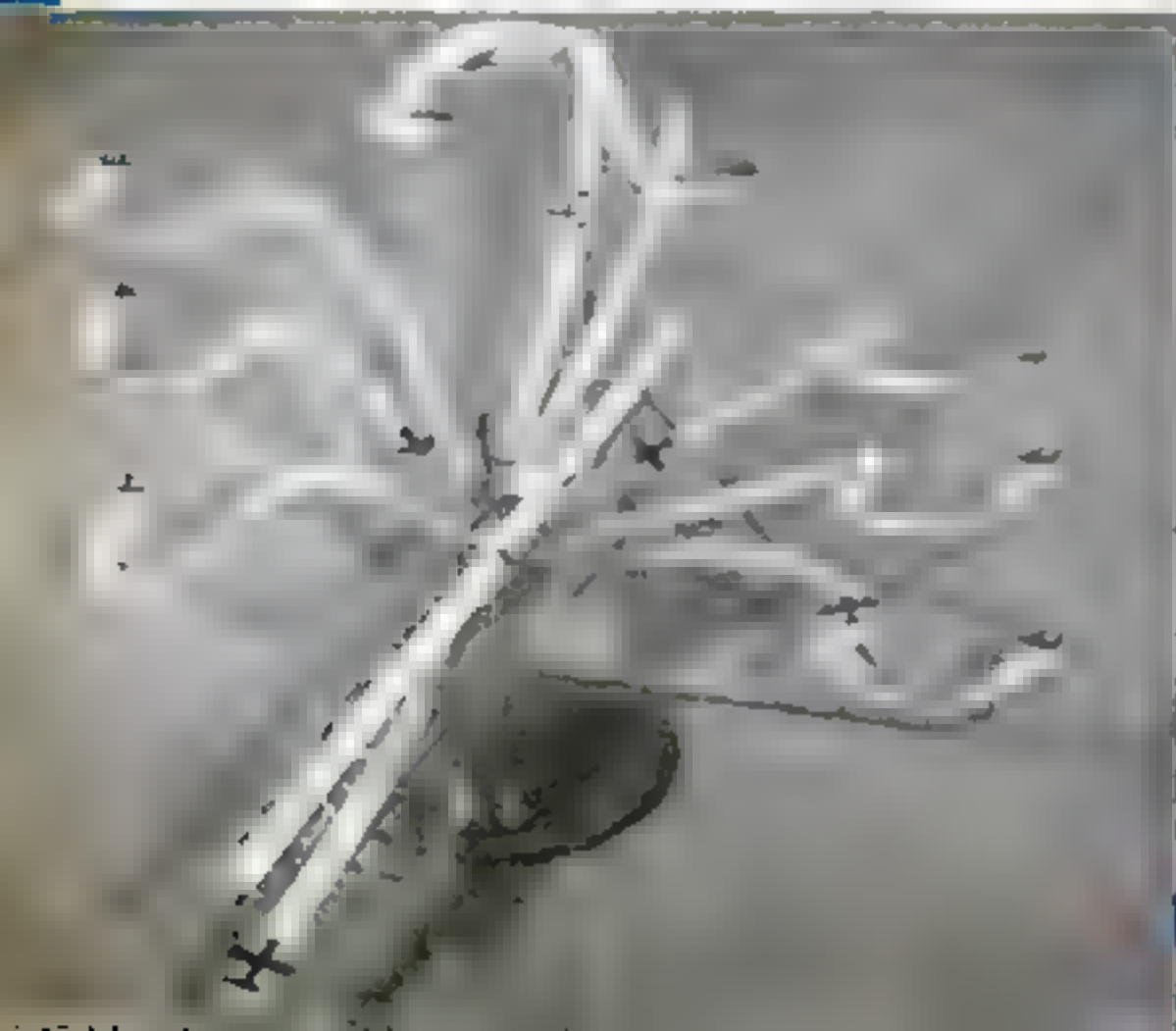




ANTI-"G" SUIT. Fighter pilots are not so likely to black out when they wear this suit with built-in air pockets (P.S.M., Jan. '45, p. 86). Air pressure from the plane's vacuum pump automatically inflates the pockets when centrifugal force raises the flyer's weight to $2\frac{1}{2}$ times the normal pull of gravity. Pressure against the abdomen, thighs, and calves is regulated to keep blood from rushing down from the head.



SHOULDER HARNESS developed by the Air Technical Service Command holds a fighter pilot against his seat in a crash landing or upside-down flying. It is locked or released by a hand lever as shown. (Courtesy Air Surgeon's Bulletin.)

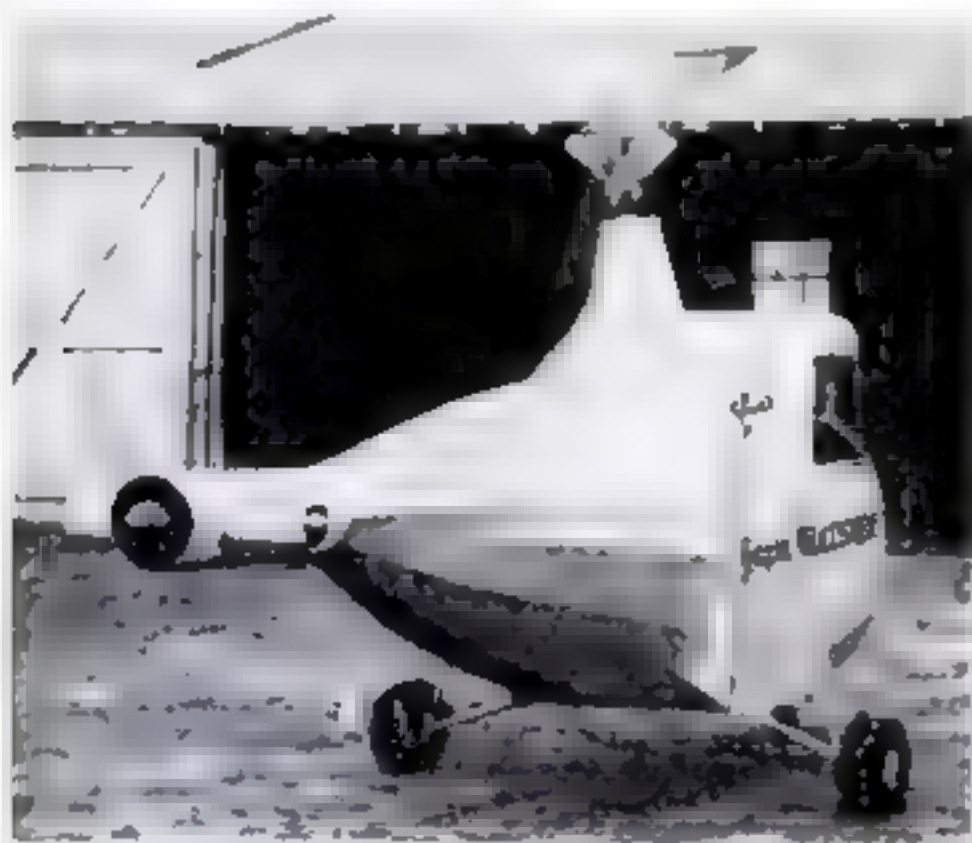


FIGHTER TACTICS against a level-flying bomber are taught to student pilots with this device developed under the supervision of the AAF Training Aids Division. A tiny model moving along a straight metal strip represents the bomber; nine other models, on curved strips, show possible fighter approaches. Each fighter path is painted to indicate machine-gun range. As the bomber model is slid along its ribbon, student pilots slide fighter models along their approaches. Bomber gunners also can use the device to learn how to guard their planes against attack. Clips hold the models on the strips.



WORLD'S BIGGEST BOMBER, the AAF's experimental XB-19A, has been given new power with the installation of four new 2,600-hp. Allison liquid-cooled engines, with turbo-superchargers and reversible-pitch

propellers. With a wing span of 212 feet, $1\frac{1}{2}$ times that of the Superfortress, the big Douglas-built plane was designed to carry 18 tons of bombs or 124 fully armed men. The Army uses it in research.



JET-PROPELLED HELICOPTER. Invented by Antoine Gazda, father of the Oerlikon 20-mm. AA cannon, this craft is designed to use a jet tube on the tail to overcome torque and to push the "Helicopster" along.

MARCH, 1945

GLIDER BOMB. Here is a specimen of another German "secret weapon"—the radio-controlled glider bomb. Nazi planes would carry these aloft and launch them against their targets, usually ships. Once on its way, the bomb would be guided by radio from the releasing plane. This sample was found by Allied troops near Paris, all packed up with no place to go.



Japs dread the sight of this versatile successor to the famous Havoc. Our fastest bomber, it doubles as fighter, night fighter, torpedo carrier, and attack plane. Painting by Eric Storm



THE HOLY GHOST SHELL, otherwise known as the sand dollar or beach dollar, is being collected by soldiers along the Carolina coast. They have learned that it symbolizes the birth, crucifixion, and resurrection of Christ. In the photograph above (right), an outline of the Easter lily is shown (A) on the top side of the shell. At the center of the lily is a five-pointed star (B) that represents the star of Bethlehem. The narrow elliptical openings (C) are

reminiscent of the five wounds made in the body of Christ during the crucifixion. On the under side of the shell is an easily recognizable outline of the Christmas poinsettia (D). When the shell is broken open, cells are found, each holding five objects that look like birds in flight (E). These represent doves. Another interpretation of these birdlike objects connects them with the angels who sang to the shepherds on the first Christmas morning.

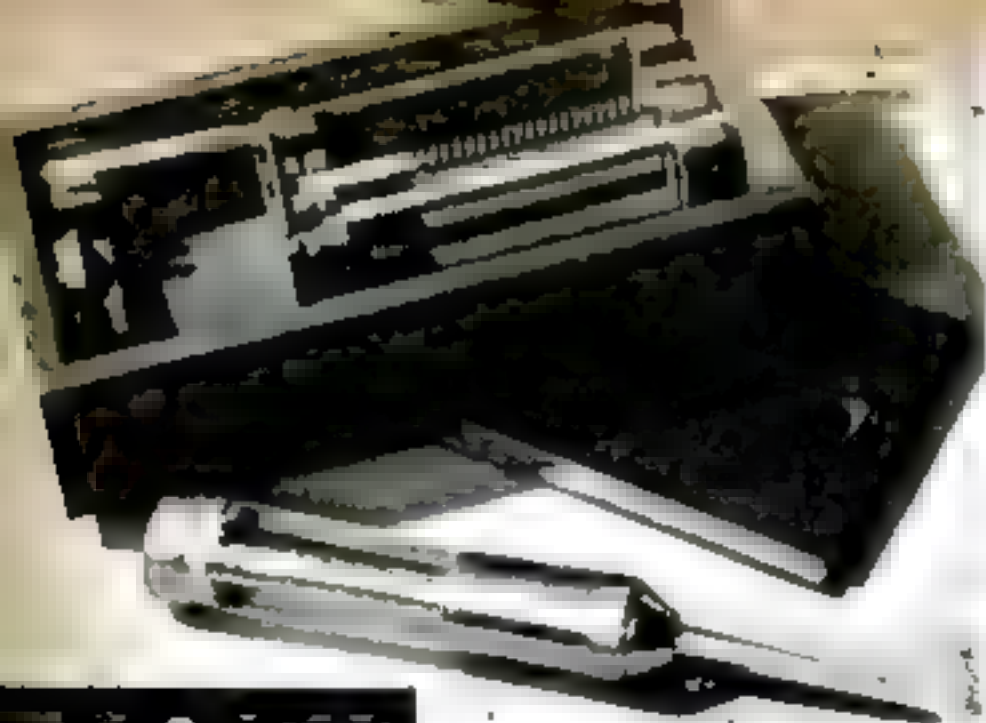
CHARTING INVASION WATERS is the big wartime job done by the Coast and Geodetic Survey in collaboration with the Navy. Shown below is the *E. Lester Jones*, one of the fleet of five vessels that survey the entire Alaskan and Aleutian coastline. It is

powered by twin 150-hp. Cooper-Bessemer model EN6 Diesel engines. The *Jones* and her sister ship *Patten* are 88 feet long, of wood construction, with 21-foot molded beam, and approximately eight-foot mean draft. They carry wire drag gear, echo sounding machines, radio for communication and for giving the ship its position within a few yards. Modern equipment allows a three-mile sounding in seven seconds while the ship travels at full speed. (This job used to take four hours.) Ordinarily a peacetime aid to shipping, the Coast and Geodetic Survey is a branch of the Department of Commerce.

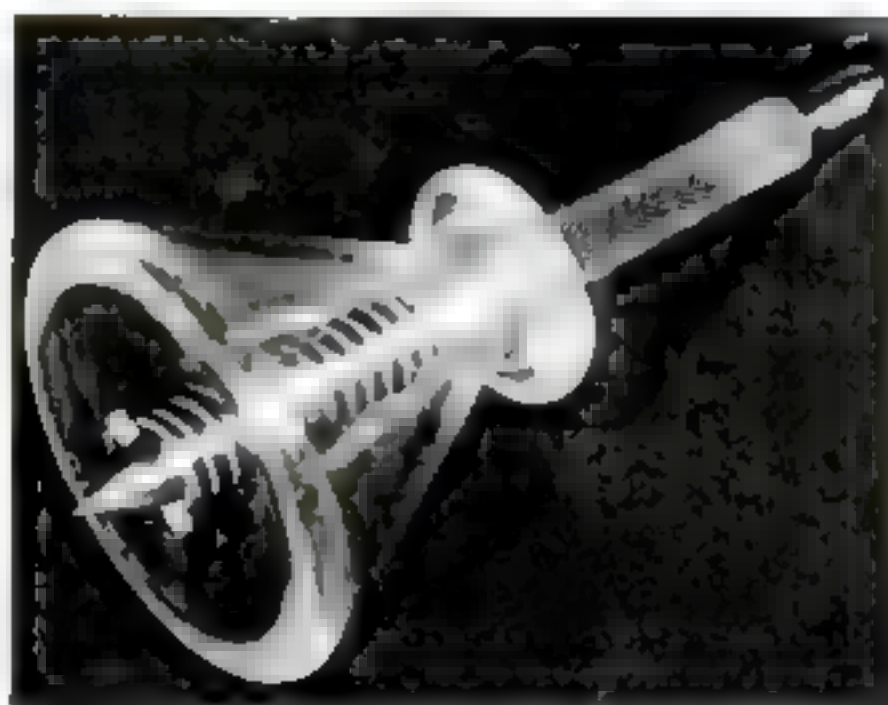




NEW Tools



TORQUE GAUGE of screw-driver type measures the relatively slight holding power of small screws and nuts both with and without lock washers. It was developed by A. C. Millard, of the Bell Telephone Laboratories, New York City. A calibrated spring connects with the cone that clamps the screwdriver or wrench socket. On the upper rim of the cone a removable collar carries a scale to indicate torque.



TRANSPARENT CENTER PUNCH has a bell cap of Plexiglas to enable the operator to position the point visually while centering holes in template work for aircraft construction. Once in place, the punch is actuated by extending a spring with a knob and letting go. At the opposite end is a convenient scriber.

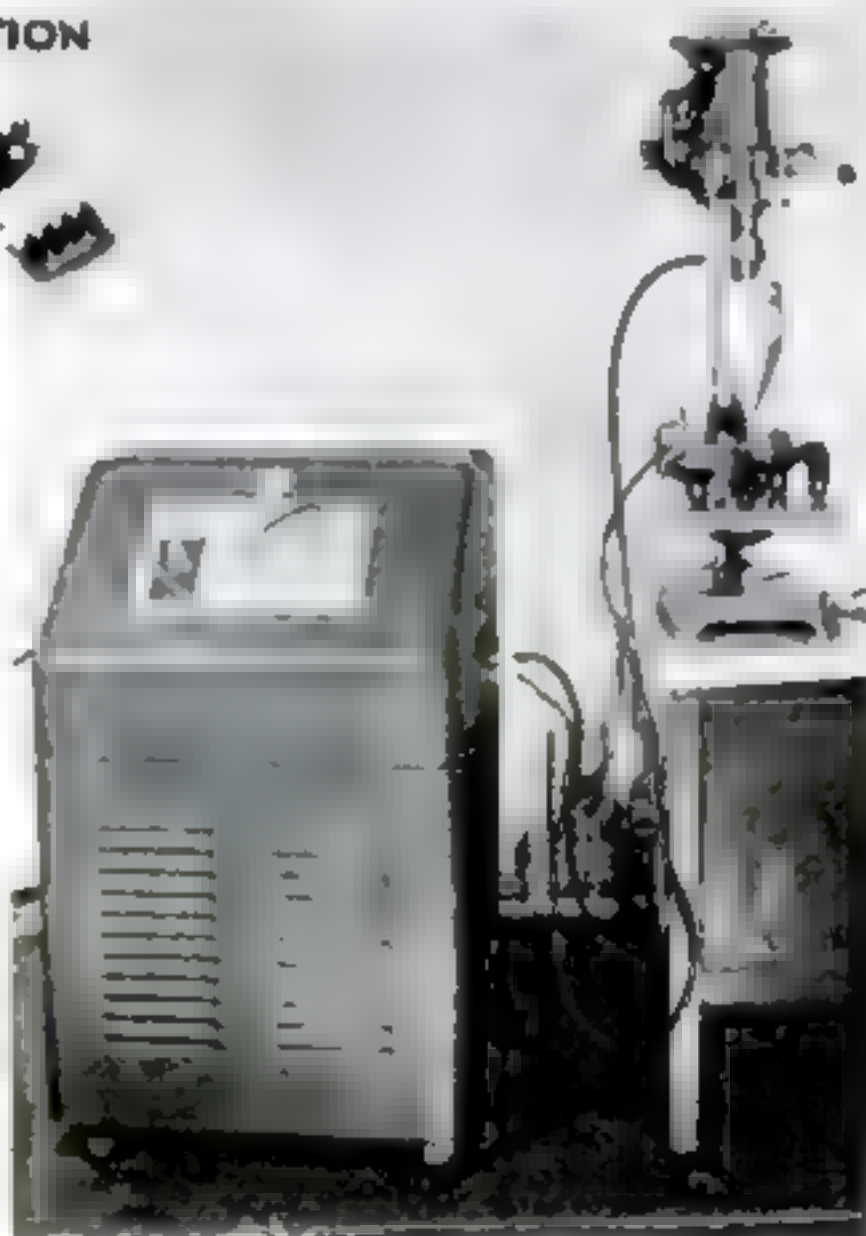
BROKEN TAP



AFTER DISINTEGRATION



STEEL DISINTEGRATOR, made by Don Thomas, of the Clinton Machine Co., Clinton, Mich., is used for electrically removing taps, reamers, and broken-off high-speed drills that have become embedded in expensive, machined pieces. A hollow copper electrode (right) is brought into intermittent contact with metal to be disintegrated by a vibrating head. As contact is broken, an arc is made, creating a highly localized heat; while the coolant, flowing through the electrode, breaks off particles by contraction.



Broken tap, embedded in a steel bearing, is disintegrated by the electrical device above for removal. Photos at left show bearing before and after the imperfect tap has been disintegrated.



MODEL TEACHES DRY-DOCKING

FINELY proportioned miniature ships are eased in and out of a scale-model dry dock at the New York Navy Yard to train naval officers in the procedure followed with real war craft. If reproduced full size on the water front, the dry dock would extend 250 feet for every normal footstep alongside the model. From it student officers are enabled to get a concise over-all understanding of the various jobs that must be co-ordinated. The model is also used to instruct shipwrights and riggers in their respective duties in connection with docking.



The miniature ships used for instruction purposes in the model dry dock were built to scale by expert civilian employees in the mold loft of the Navy Yard. They are almost perfect reproductions of the large vessels constructed in the yard for actual naval duty with the United States fleet.

Student officers assembled with their instructor around the model reviewing various steps in dry-docking. There are four phases: preparation of the dock, preparation of the ship, docking, and undocking. Each involves many operations vital to safety of ship and personnel.



Model dry dock at the New York Navy Yard is used in the training of Navy men as docking officers. An idea of the scale may be had by the types of miniature vessels shown docked. Over-all view gives student officers better comprehension of operations than if they first see them on a full-size dry dock. Also, the teacher can accent operations by repetition.





FIRST-PRIZE WINNER IN PROFESSIONAL CLASS INCLUDED

GENERAL DESIGN: Low-wing, four-place monoplane with twin tail booms, pusher propeller, and tricycle gear. **COST:** Around \$2,000.00. **PERFORMANCE:** Speed of around 115-135 m.p.h., range of 500 miles; good maneuverability and ground-handling characteristics; slow landing speed; and economy of operation.

COMFORT: Plenty of leg room, visibility, quiet operation; ash trays, sunshades, adequate baggage space; heating and ventilation equipment; split front seat, doors on either side; minimum of engine vibration. **SAFETY:** Tricycle landing gear gives easy landings and ground-handling characteristics; flaps permit slower

These Are the Planes

We asked the private flyers of tomorrow to write their own ticket. The analysis of 3,345 contest entries shows what they are looking for.

A DRAFTSMAN in the evergreen section of the Pacific Northwest wrote **POPULAR SCIENCE MONTHLY** last fall that of all the things he would like to see incorporated in his postwar private airplane, a foot throttle was on the high-priority list.

He wanted other items of comfort, too, did Tom Phelan of Seattle—a cigarette lighter on the instrument panel, and arm



MANY FEATURES THAT INDICATE FUTURE POPULAR TRENDS

landings, spoilers give better glide control; boom on-
 close propeller; fire extinguishers, two-way radio;
 spinproof and stallproof features; hydraulic brakes; all
 knobs flush with the instrument board. ACCESSORIES:
 Dual or throw-over controls; landing lights, self-starter,
 heater, glove compartment; all flight instruments; safety

belts; emergency tail shield; wheel pants. This prize-
 winning design in the professional class was sub-
 mitted by Donald J. Wheeler, an engineer in the
 Boeing Aircraft Company's plant at Seattle, Wash. It
 was selected for reproduction here because it embodied
 many features preferred by a majority of entrants.

You'll Fly After the War

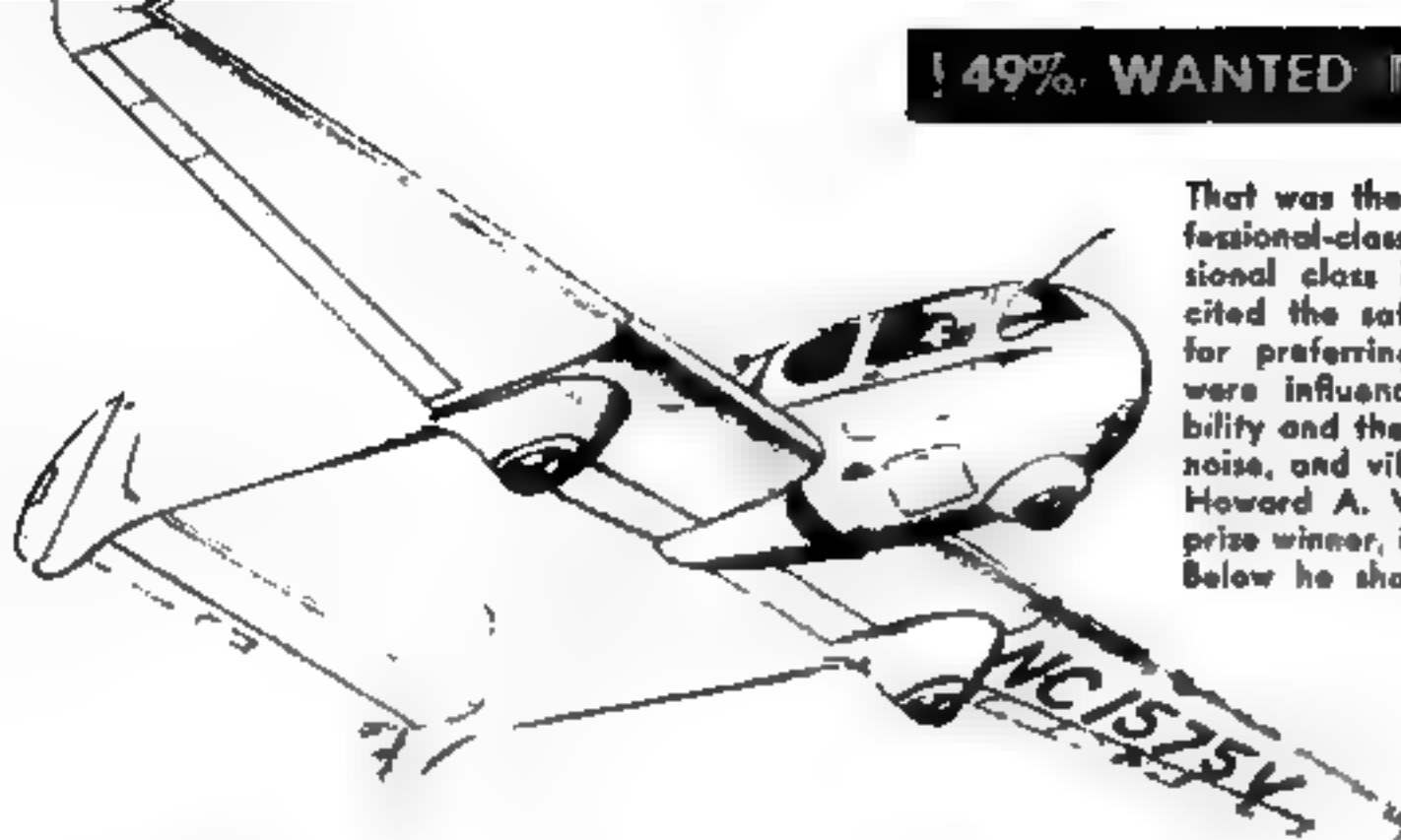
rests built into seats for his passengers.

Tom Phelan was one of the many en-
 trants in this magazine's "The Plane You'd
 Like to Own" contest, concluded September
 30, who displayed a flair for merchandising.
 The automobile never would have sold in
 the millions if it had not had, first, utility;
 and second, comfort.

The personal-type airplane won't sell in

the postwar years unless it has both in
 generous proportions. Comfort runs a close
 second to safety—which is first on the list
 of demands, by the way—in the features
 tabulated by the board of judges from the
 3,345 entries in the contest. After safety
 and comfort come good looks, practica-
 bility, and performance, in that order.

In the December issue we announced



That was the proportion among nonprofessional-class entrants; in the professional class it was 45 percent. Many cited the safety factor as their reason for preferring the pusher type; others were influenced by the improved visibility and the reduction of engine fumes, noise, and vibration. This sketch by Cpl. Howard A. Wolf, nonprofessional third-prize winner, illustrates these advantages. Below he shows his plane in three-view

the winners in the contest, which drew designs from each of the 48 states and 10 foreign countries, and briefly sketched the outlines of the composite aircraft that the buying public will want when the war is over, as reflected in those designs.

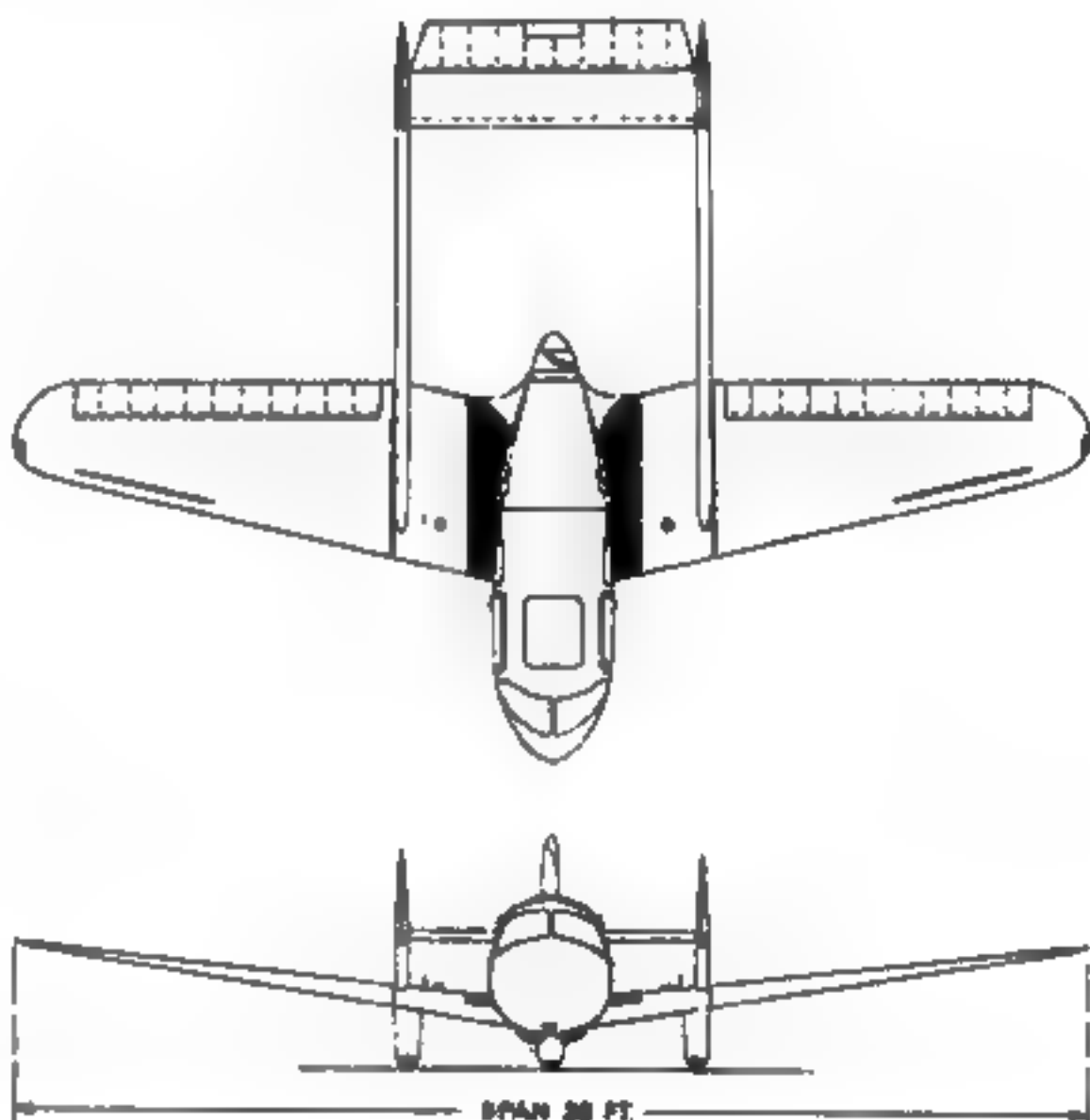
This month we are going to make a recapitulation and draw up a bill of particulars. How many of the entrants wanted folding wings? How many wanted slots and flaps, those devices that make for greater safety in flying? How many wanted two engines instead of one? Two-control aircraft?

Some of the answers are surprising. They surprised the judges, and they surprised the staff of POPULAR SCIENCE MONTHLY, which, in the intervening months, has had an opportunity for a more leisurely analysis of the results.

The designs submitted reflected credit on the readership of the magazine. The entrants knew what they wanted. And what they wanted is a fair sample of the public's tastes in personal air transportation.

As Oliver L. Parks, a member of the judges' panel, put it: "This contest has advanced the thinking and engineering development at least a year in private-plane manufacture."

Composite pictures, like general averages, are intriguing for what they determine in establishing the likeness of the thinking of large segments of the population. If the readers of POPULAR



SCIENCE MONTHLY have their way, here is a composite picture of your postwar private plane:

- A monoplane, with a low wing
- An engine of about 125 horsepower
- A landing gear of tricycle design.
- A capacity of four persons.
- A speed of about 130 miles an hour.
- A range of about 500 miles between refuelings.

In outline the plane will be a wing cradling a fuselage that will carry its power plant in the rear. On either side of the fuselage, anchored to the wing, will sweep

8% WANTED A MID-WING MONOPLANE

While only eight percent of the nonprofessionals specified the mid-wing type, 17 percent of the professionals preferred it. The photo shows a gas-powered scale model of the mid-wing design submitted by Carl W. Thompson, Jr., New Castle, Del., to win fifth prize in the nonprofessional class. The model, by the way, flies very well



ANALYSIS OF ENTRIES IN POPULAR SCIENCE MONTHLY "THE PLANE YOU'D LIKE TO OWN" CONTEST

These are the percentages of the class total and indicate which designs incorporated or consisted of the following: (NP—Nonprofessional and P—Professional entries)

Helicopter
Low-wing
High-wing
Mid-wing
Tailless
Amphibian
Roadability
Triple gear
Retracting gear
Tail boom
Pusher props
Seats

NP 100%
P 100%
NP 100%
P 100%
NP 100%
P 100%
NP 100%
P 100%
NP 100%
P 100%
NP 100%
P 100%

Radio
Wood or plastic
Folding wings
Jet engines
Spinproof
Two control
Slats & flaps
Variable prop
Self-starter
Built-in fire extinguisher
Seaplane
Twin engines
Twin rudders
Power glider
Open cockpit
Biplane
Kerosene
Speed limited (M.P.H.)
Press pilot
Sundervators
Stainless steel
Diesel engine
Rear-view mirrors
Propeller behind tail
Parachute for pilot
Self-rotating tires
Variable-camber wing
Windshield wipers
Built-in bed
Soundproofing
Tail-first design
Prop around tail boom
Rocket assist
Telescoping wings
Radial engines
Spoiler ailerons
Range in miles
Dual controls
Throttle-over controls
One engine, two props
Hare baggage room
Glove compartment
Ash trays
Extra leg room
De-icers
Sunshades
Automatic pilot
Flying wing
Better visibility
Went safety first
Ice-box unit
Built-in heater
Good ventilation
Automatic trim tabs
Television unit
Anti-collision device

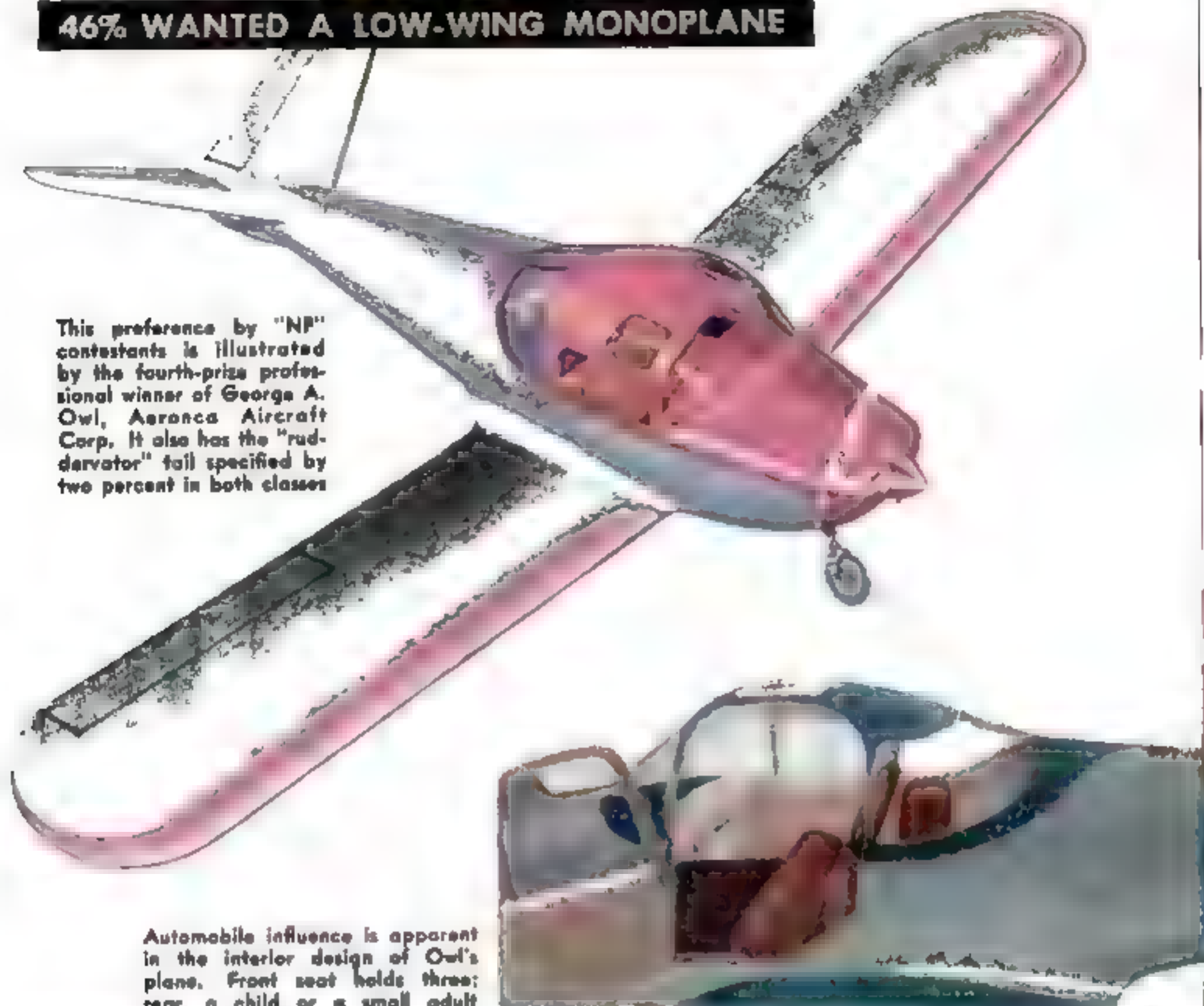
NP 100%
P 100%
NP 100%
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NP 100%
P 100%

BREAKDOWN of preference percentages reveals interesting differences between professional and nonprofessional entrants. For example, "NP" designers favored the low wing, while "P" class entrants went in more heavily for high wings. Preferences may show only personal taste

46% WANTED A LOW-WING MONOPLANE

This preference by "NP" contestants is illustrated by the fourth-prize professional winner of George A. Owl, Aerona Aircraft Corp. It also has the "rudervator" tail specified by two percent in both classes

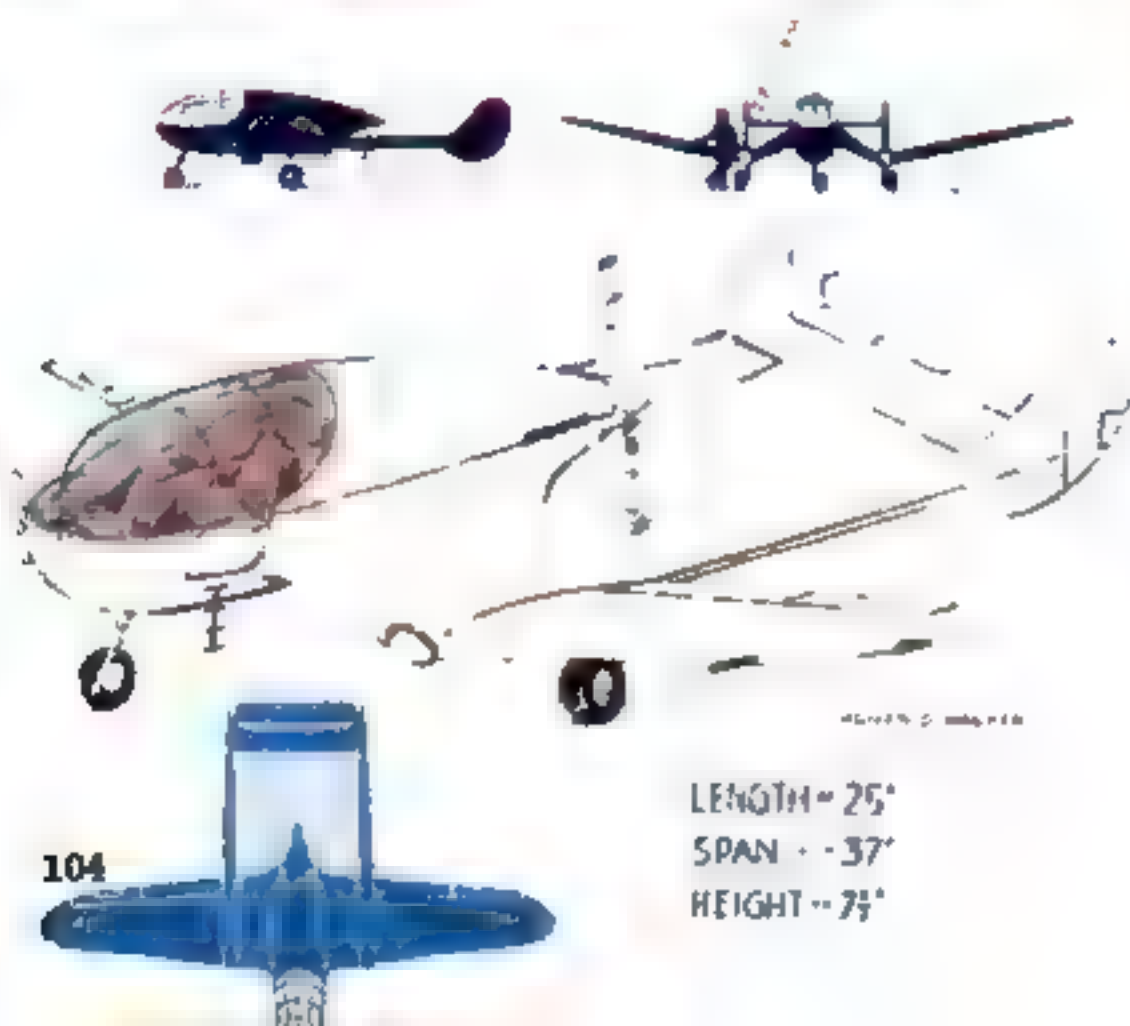


Automobile influence is apparent in the interior design of Owl's plane. Front seat holds three; rear, a child or a small adult

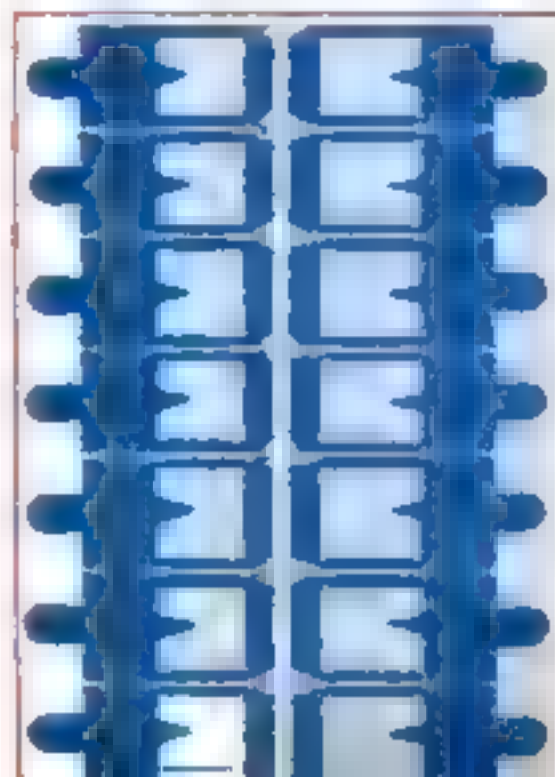
14% WANTED FOLDING WINGS

Many entries in both classes featured wings that could be folded, usually in conjunction with roadable design. When roadability was not considered,

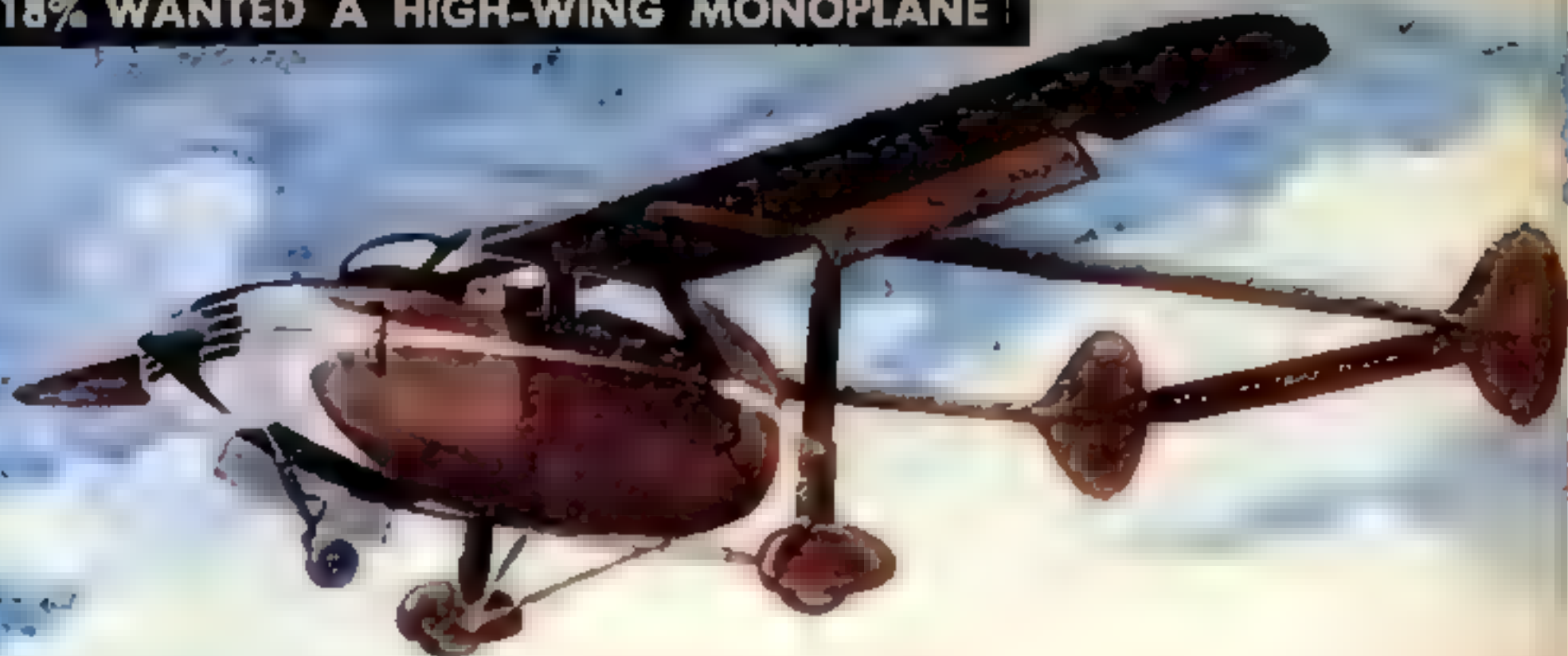
the popular method of folding the wings was that used in the entry of Homer O. Hocker, "NP" second-prize winner, of Dayton, Ohio, whose original sketch is reproduced at left, below. In the drawing directly below, Hocker shows how compactly such planes, with their wings folded, can be stored in a hangar. This entry included many features that rated high preference among all the contestants



LENGTH - 25'
SPAN - 37'
HEIGHT - 7 1/2'



18% WANTED A HIGH-WING MONOPLANE



That was the vote among nonprofessionals; "P"-class entrants went 36 percent for the high wing. This interesting example with twin tail booms was submitted by Nicholas F. Pederson, of Hasbrouck Heights, N. J. Note that his design features flaps and a nose wheel that retracts through doors in the fuselage

back a boom to accommodate the tail stabilizing and control surfaces.

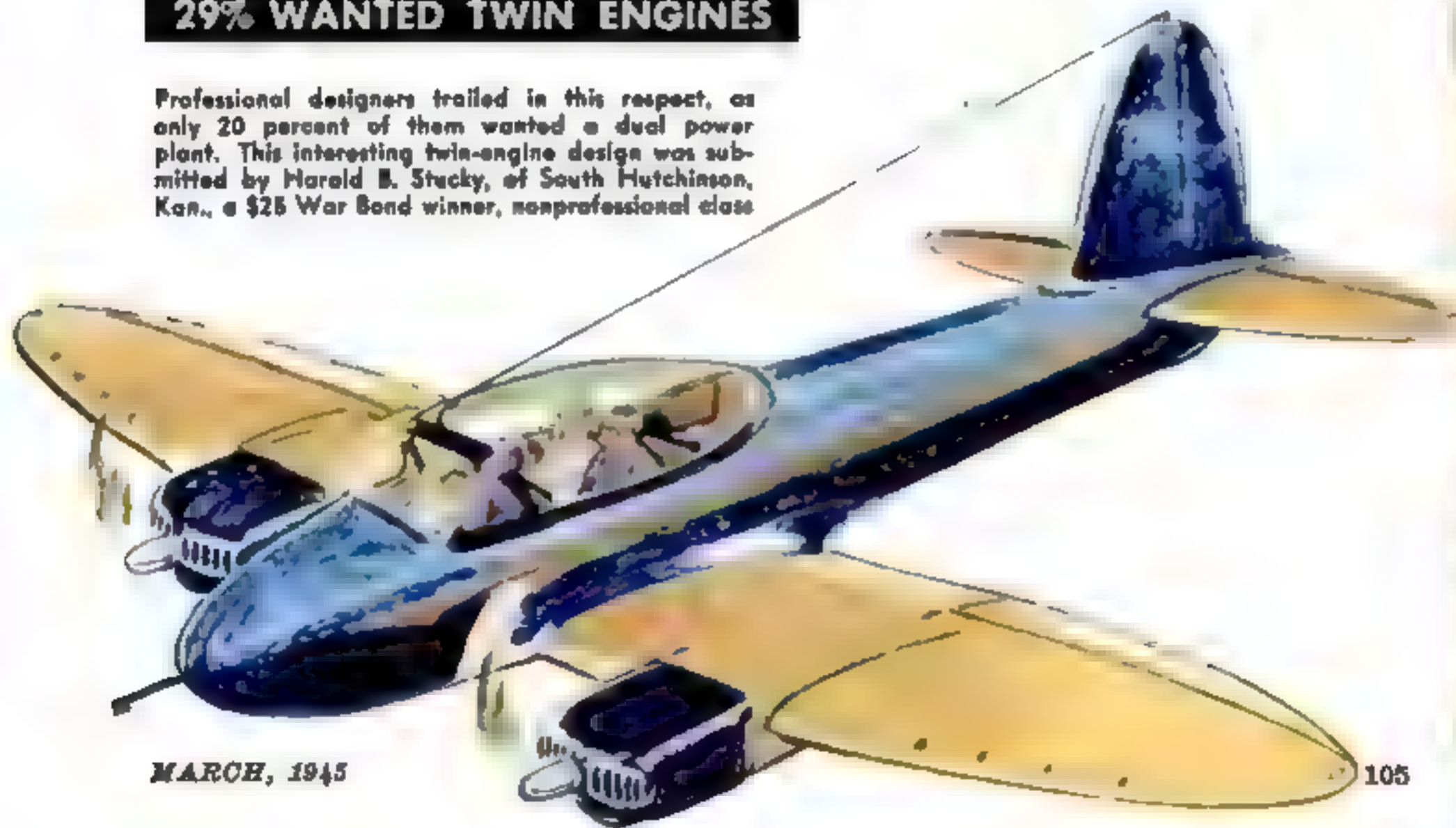
Safety considerations, of course, came first. That was natural. Americans have always demanded a high safety factor in their automobiles; it is even more impor-

tant in planes designed for private flyers.

On tricycle landing gear the majority was agreed. There is a story behind that. As a safety factor, tricycle gear was a feature of practically all the earliest airplanes, built just after the turn of the

29% WANTED TWIN ENGINES

Professional designers trailed in this respect, as only 20 percent of them wanted a dual power plant. This interesting twin-engine design was submitted by Harold B. Stucky, of South Hutchinson, Kan., a \$25 War Bond winner, nonprofessional class



MARKINGS on instruments to show safe operating conditions were suggested by Herman Carpenter, Raleigh, N.C.



HAT RACK proposed by C. Pearson, Los Angeles, and A. V. St. Germain Dayton, Ohio

DOOR LATCH was an idea of Pfc. Richard Park, of New York

AUXILIARY fuel tanks for luggage compartment. From Lt. William Craig, of Lemore, Calif.

WINDOW in floor of nose for landings. Suggested by Lt. James W. Shield, of Deming, N. M.

SUN SHADES, accordion pleated, keep glare out of cockpit of the plane designed by William Drake, Malden, Mass.

century. A tricycle-undercarriage plane sits on the ground with all the stability of a milkmaid's stool. It permits the wing to be at a negative (no lift) angle of attack at the start of the take-off run and during the landing run.

Tricycle wheels afford a pilot a lot more visibility than does the more conventional undercarriage. The nose doesn't stick up to obstruct his view of the ground while taxiing. Moreover, as an added safety factor, a tricycle-wheel job can be taxied in circles by a novice in a 40-mile wind. It takes an expert touch on the controls to do that in a plane equipped with two main wheels and a tail wheel.

One of the principal reasons why tricycle gear was abandoned as the airplane grew up was that a level wing provides no braking action in the landing run. In those days, wheel brakes were unknown, and the "drag" of the up-tilted wing was counted on to bring a plane to a stop more quickly. Today, good brakes enable a pilot in a three-wheeled plane, coming in for a landing at considerable speed, to stop as "short" as a pilot using conventional gear in a full-stall landing.

Nearly 75 percent of the nonprofessional entrants and more than half of the professionals specified tricycle undercarriages.

Then there was the problem of propeller placement. A whirling propeller is potentially dangerous. People can walk into it on the ground—as not a few have. So nearly 50 percent of all entrants in both classes wanted the propeller in the rear of the cabin, enclosed in most instances between twin booms extending backward to carry the tail stabilizing and control surfaces.

The contestants had other reasons for favoring pusher propellers. Since the propeller creates much of the noise developed by an airplane in flight, putting it in the rear reduces the noise level. The pusher provides better visibility forward, reduces the chance of getting engine fumes in the cabin, and—an important safety consideration—creates less danger to the occupants in case of fire.

Incidentally, speaking of engines, that jet-propelled design of Pfc. Don L. Fotheringham, U. S. M. C., FPO, San Francisco, winner of the \$1,000 War Bond first prize among the non-

professionals, created quite a stir. It was revolutionary thinking. But his ideas had solid support. The turbine—related in principle to jet propulsion—has been adapted to locomotives by one of America's big railroads, and automotive engineers are talking freely of the day when the gas turbine may replace the internal-combustion reciprocating engine in your automobile.

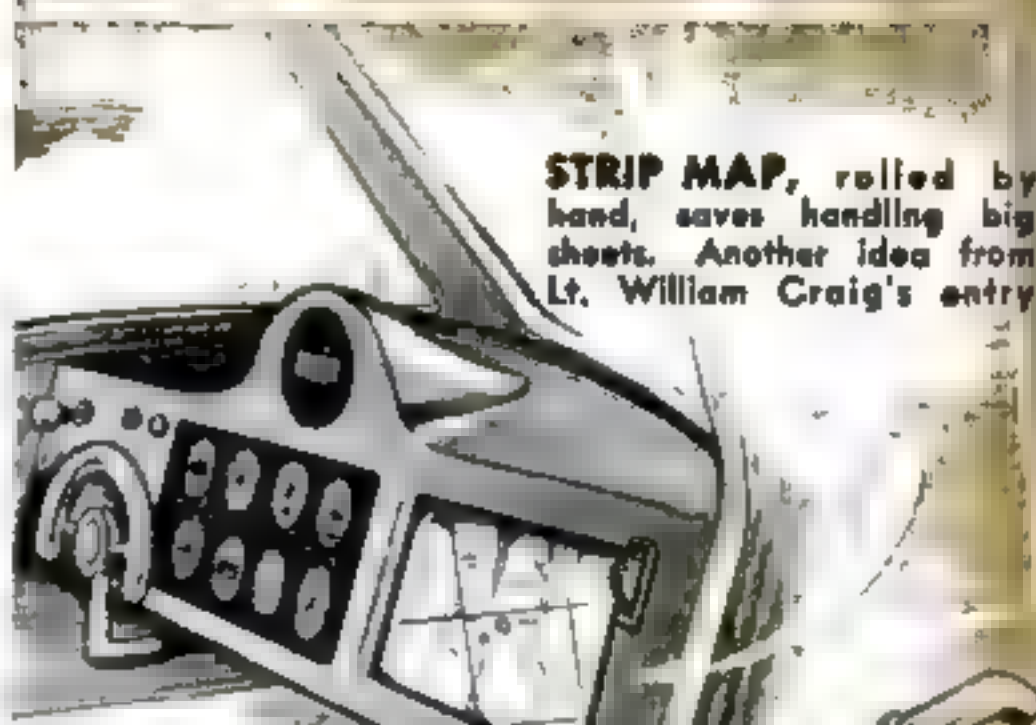
But only six percent of the non-professionals wanted jet-propelled craft, and only half that proportion of professionals favored them.

Safety, of course, meant the incorporation in the designs of the standard devices to insure control at low speeds. Forty percent of the entrants in each class specified slots and flaps. The slot insures a smooth flow of air over the ailerons for lateral control when the wing is at, or even below, the stall point. The flap, called a "high-lift device" by the engineers, actually adds to the wing area or so changes the shape of the wing as to achieve the same result.

Interestingly enough, only 14 percent of the nonprofessional entries and 18 percent of the professional were designed to be spinproof. Yet there was no lack of ideas for other safety devices. Charles E. Planck of Arlington, Va., for instance, favored the installation of a stall warning device on the leading edge of the wing. Partly as a safety factor, 29 percent of the nonprofessionals and 20 percent of the professionals specified two engines. Stanley D. Whitaker, of Los Angeles, winner of a \$25 War Bond in the professional class, submitted a design with wings that pivoted to maintain a correct angle of lift regardless of the attitude of the plane as a whole.

Another entry figured that small rocket units attached to the underside of the wing would give his plane that extra speed he would need in an emergency. He was on solid ground, too—U. S. military planes now use rocket-assisted take-off. Not to be overlooked was a suggestion by Murrel D. Hobt, at the AAF convalescent hospital in St. Petersburg, Fla., that spring-fitted safety belts be provided.

Comfort features abounded. If there is anything typically American, it is a demand for comfort. Many of the entries included a commercial band on their radio sets for enter-



STRIP MAP, rolled by hand, saves handling big sheets. Another idea from Lt. William Craig's entry

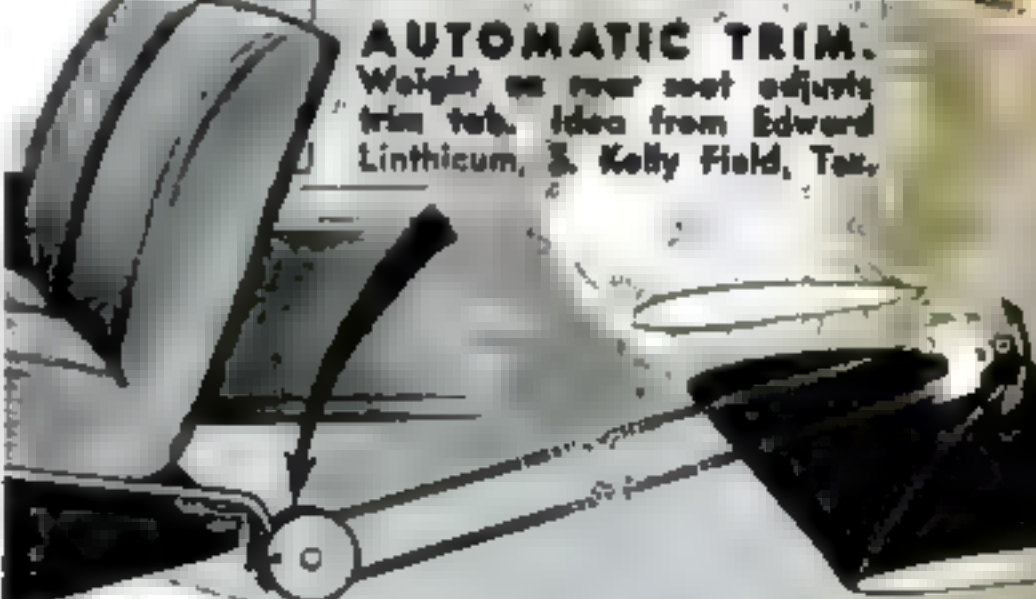
SPOTLIGHT under the nose for night landing. Moved by hand. Idea of Howard L. Lundy, of Washington, D. C.



VARIABLE CAMBER. To change wing camber, rubber upper surface is inflated. Idea of Myron Popow of San Antonio, Tex.



AUTOMATIC TRIM. Weight on rear seat adjusts trim tab. Idea from Edward Linthicum, S. Kelly Field, Tex.



AMPHIBIAN FLOAT, turned on side, has wheel for landing. Suggested by Carl Brown, of Hazel Park, Mich.

tainment during those long hours in the air on cross-country trips. And there was something else behind that, too: a simple "homing loop" on an airplane, tuned to a commercial-band broadcasting station, can be of inestimable value in air navigation.

The enemy knows that. That's why he shuts off his broadcasting stations when our bombing fleets take off to saturate his war industries with explosives.

There were other items of comfort specified: rear-view mirrors, so a man wouldn't have to twist and turn in his seat to see what was behind him as he made a turn or a climb; better ventilation, glove compartments, ash trays, sunshades, heaters, extra leg room, and plenty of baggage room. The owner of a personal-type air-

plane can't get full utility out of it unless he has space to stow away his fishing tackle, golf bag, a picnic hamper, bags, and Junior's playthings.

Homer O. Hacker, of Dayton, Ohio, who collected \$500 in War Bonds as second-prize winner in the professional class, wanted built-in hangers for coats and spare jackets. And, to simplify the job of tying down his aircraft for the night, he included a steel roll-up device for the underside of the wing that could be attached to a stake or other object.

Several designers, including Harold B. Stucky, of South Hutchinson, Kan., winner of a \$25 War Bond in the nonprofessional class, specified a ladder for easy entrance to his airplane. Other entrants had their

10% WANTED ROADABILITY

A surprise to the judges was the relatively small percentage of contest entrants seeking a combined plane and auto. This tailless model was designed by Ray Ring, of Framingham, Mass.

ladders sliding out of the floor or door, and even out of the wing. Going the whole way on comfort, some designs were complete with built-in beds.

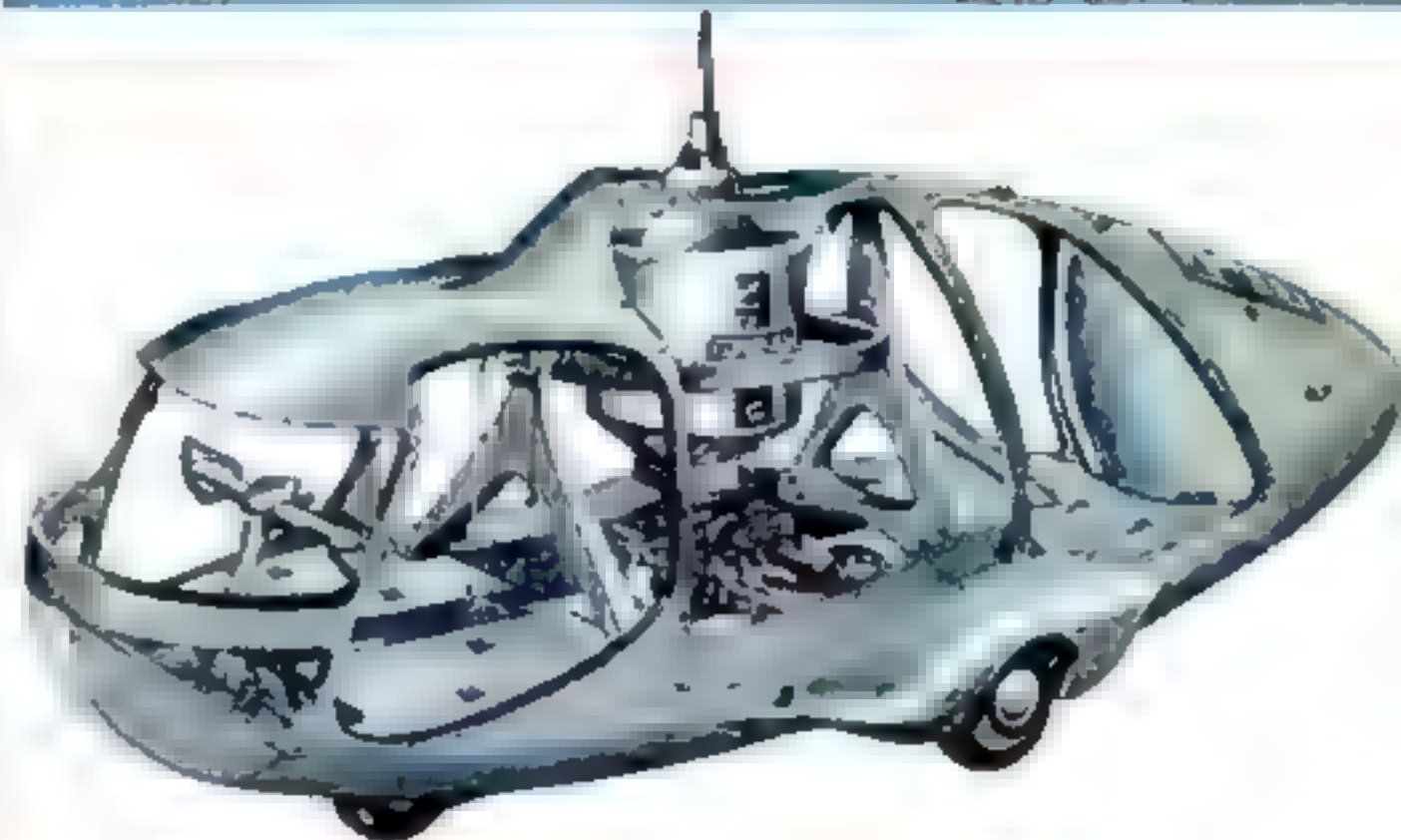
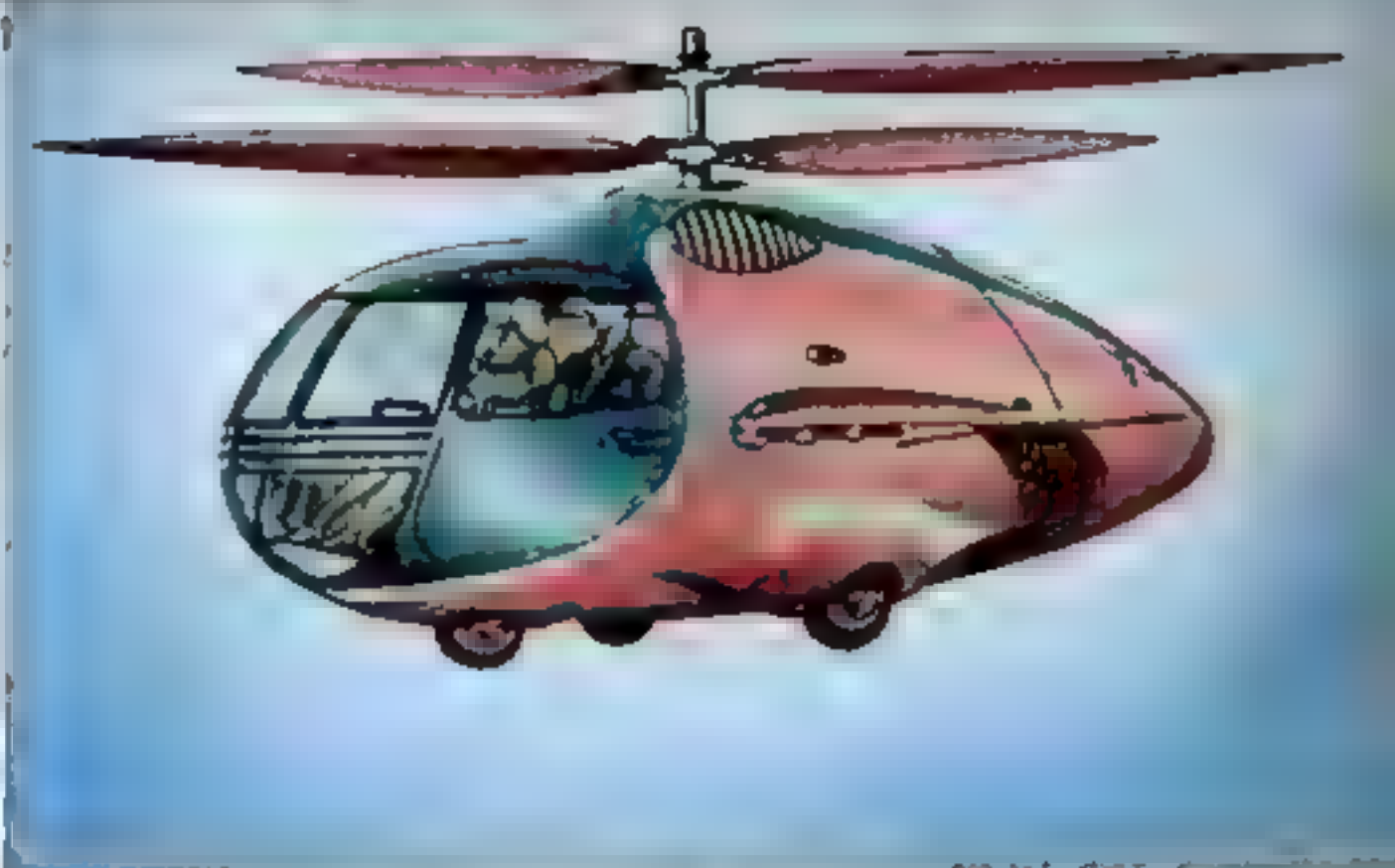
More than half the non-professionals wanted four-place planes, while 43 percent of the professionals said that would be the amount of seating capacity they would require. Several designers suggested a front seat wide enough for three people and a small fold-up seat behind it.

But—and here was a poser for the judges—only eight percent of the non-professionals and six percent of the professionals wanted planes with two controls instead of three. A two-control airplane dispenses with rudder pedals by integrating the rudder control with the ailerons or by carrying a fin so designed as to overcome the normal "yawing" movement in a turn.

The chances that your postwar plane will have a wing attached to the bottom, instead of to the waist or the top, of the fuselage are pretty good, judging by the contest preferences. Almost every second one of the nonprofessional entrants preferred the low wing. Only every fourth one of the professionals wanted it. If you fly an airplane, you know what the choice between the low wing and the high wing comes down to: largely a personal preference.

In a turn, a high wing blanks out the area into which you are turning. A low wing blanks out your view of the ground. A high wing has "pendular stability." A low wing provides a lot more all-around visibility. A high wing supplies clearance over such ground objects as bushes. A low wing is cleaner and has less "drag" because normally it has no struts.

The nonprofessional contestants favoring high-wing monoplanes ran to 18 percent, while the professionals totaled up to 36 percent; the mid-wing type enjoyed a vote of eight percent among the nonprofessionals and 17 percent among the professionals.



Another surprise was the small number of contestants pinning their hopes on rotating-wing aircraft. Fifteen percent of the nonprofessionals and 10 percent of the professionals favored helicopters. This exceptionally detailed design and construction plan was entered by Cpl. Robert W. Huzzard, of Wilmington, Ohio. It has contra-rotating rotors

Then there was the vote on amphibians. The amphibian is a sort of jack-of-all-trades. If a smooth landing surface is available on the ground, the amphibian can use its wheels. If it can't find smooth ground, or if the pilot simply chooses to use a water surface by preference, it can be put down on a lake, a river, or the protected blue water of a cove. The pilot who likes to operate off water makes an interesting discovery when he begins exploring the surface of continental United States: it is pitted with depressions full of water. One pilot using an ordinary seaplane flew all the way across the northern tier of states from the Atlantic to the Pacific and never lacked a landing place.

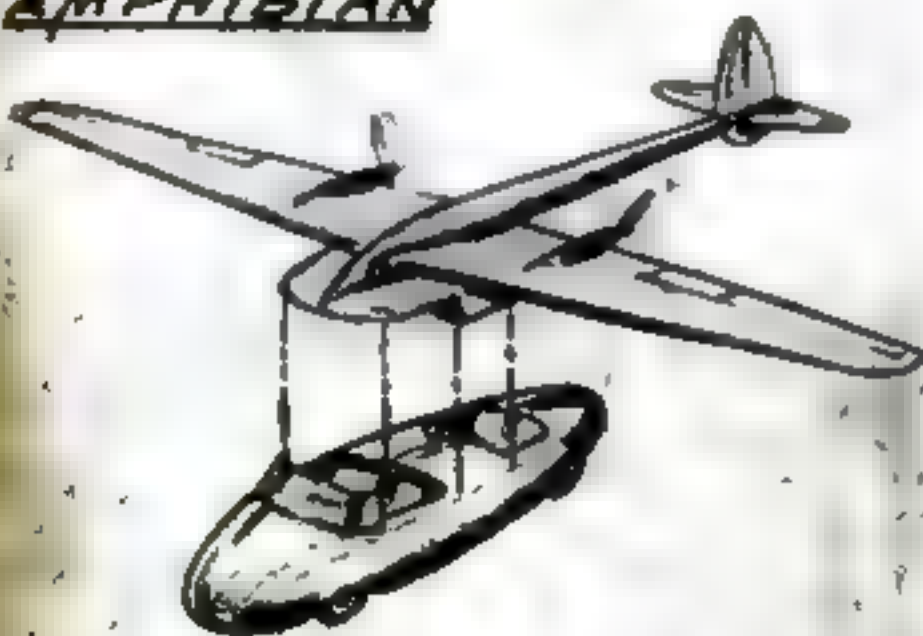
One out of five of the professional entries



AIRPLANE



AMPHIBIAN



OPENED CAR



CLOSED CAR



BOAT

The versatile personal plane seen at left in drawings by A/S Perry S. Clark, of La Junta, Colo., was among the 20 percent of professional entries favoring land-and-water craft, as against 16 percent of the "NP" class. It serves not only as an amphibian plane but also as an open car, closed car, and boat

and 16 percent of the nonprofessional specified an amphibian-type airplane. Louis Aron of Hamilton, Ont., entered a design with wheels fitted into the sponsons, or water stabilizers. Mounted horizontally when the plane was water-borne, they were turned downward for land operation. The third prize winner in the professional class, AAF Capt. Adam J. Stalzenberger, Wright Field, Dayton, Ohio, submitted a sleek, two-place amphibian with a molded plastic hull. He used wing floats as housings for wheels. His design won him \$300 in War Bonds.

The straight seaplane fared badly. It drew support from only five percent in each class of entry.

There were other surprises. Notwithstanding the considerable publicity given rotating-wing aircraft in the last two years, only 10 percent of the professional and 15 percent of the nonprofessional wanted whirligigs. Of the contestants who did submit designs with whirling wings, two gave the judges pause. Henry G. Howell, of Los Angeles, submitted a two-bladed "paddle wheel" helicopter intended to carry two passengers. Another, also for two passengers and fitted with four blades operating on contra-rotating hubs, was entered by Cpl. Robert W. Huzzard, of the Clinton County Army Air Field, Wilmington, Ohio.

The judges frankly had some preconceived notions of what kind of designs would be submitted in the contest. They figured, for instance, that the readership of POPULAR SCIENCE MONTHLY would heavily favor types of planes that could be converted to highway use. And they found that they were mistaken.

The vote on "roadability," as it is called, ran even lower than that on rotating-wing aircraft. Nevertheless, some novel roadable-plane designs showed up. H. D. Boggs, of Omaha, Neb., for instance, drew up a fuselage that could shed its wings and be cradled in an automobile chassis for highway use. For flight, the fuselage was lifted from the chassis and fitted with wings. A single engine, both for the road and for flight, was mounted in

road and for flight, was mounted in the fuselage.

Incidentally, but 14 percent of the non-professionals and seven percent of the professionals wanted folding wings.

The professionals practically ignored airplane construction incorporating plastics or plastic-impregnated plywood. Seven percent of them liked plastics. But 20 percent of the nonprofessionals toyed with the idea of plastics.

The choice on aircraft prices in relation to speed, carrying capacity, and solidity of construction was one of the biggest surprises of the contest. It was natural to assume that the public would want a low-priced airplane. A decade ago a Government department, in fact, publicly encouraged manufacturers to produce a "\$700 airplane" for the average family purse in the thought that a modest price would lead to more widespread private flying by putting airplanes within the reach of a larger proportion of the population.

But the contestants said most emphati-

cally no, they preferred to buy planes priced in the same class as the better automobiles. They wanted nothing under \$1,000 if it didn't pay for a better type of aircraft, and they backed up their statement with designs that included luxury items. Luxury items cost money.

POPULAR SCIENCE MONTHLY is proud to have sponsored the "Plane You'd Like To Own" contest. It set a high-water mark in surveying the public's tastes in postwar personal-type aircraft. Magazines and newspapers throughout the country printed news stories about it. Undoubtedly, it will contribute to the advanced thinking going on in the rooms marked "No Admittance" in factories where tomorrow's designs are in the making.

Planes incorporating many of the features in the plane you'd like to own will be rolling off the assembly lines pretty soon.

When, at last, you are able to walk into a salesroom on "airplane row" and pick out a sky runabout, it will show the results of this sampling of private-flyer opinion.

ENTRIES INCLUDED MANY NOVEL CONSTRUCTION IDEAS

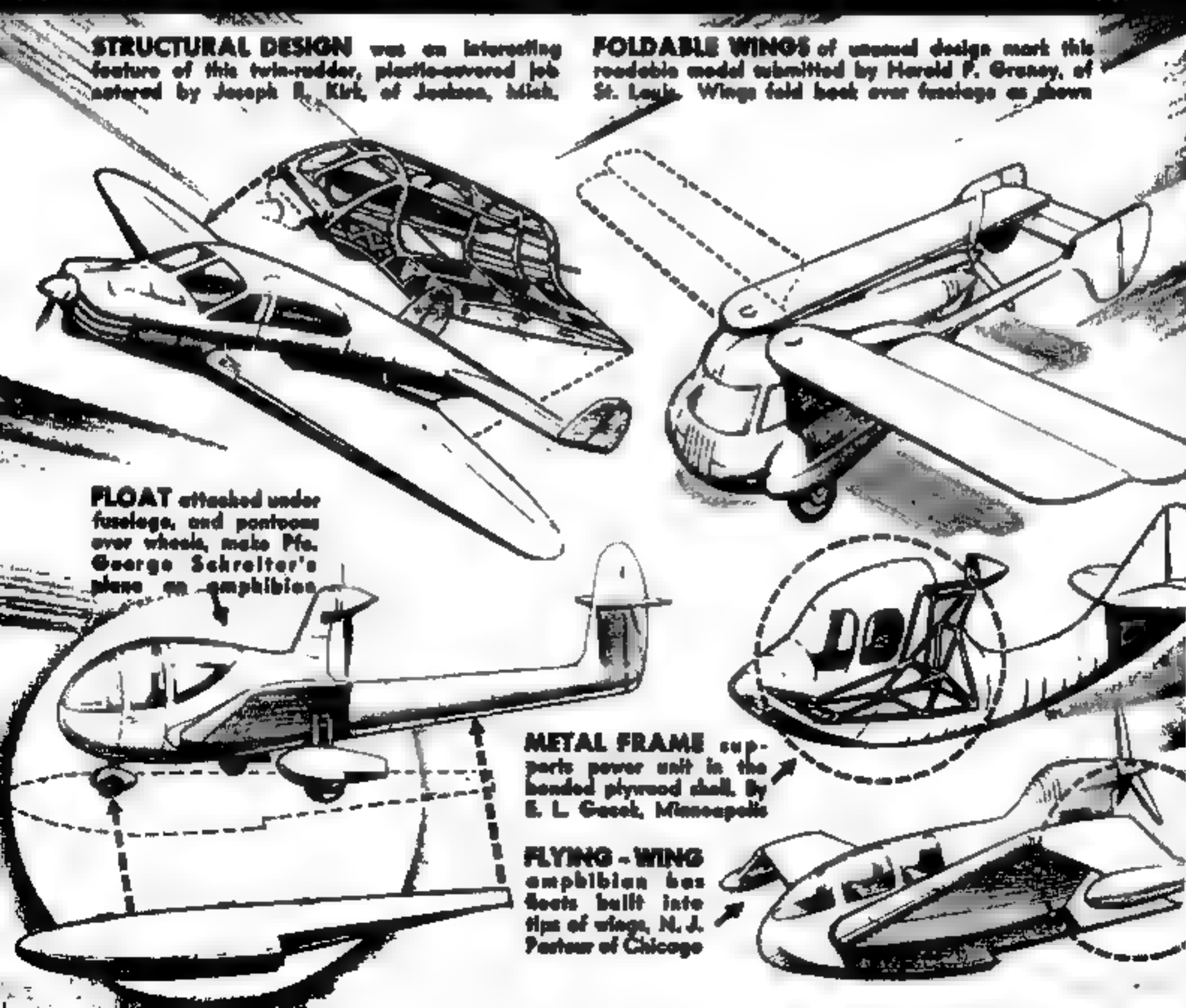
STRUCTURAL DESIGN was an interesting feature of this twin-rudder, plastic-covered job entered by Joseph R. Kirk, of Jackson, Mich.

FOLDABLE WINGS of unusual design mark this roadable model submitted by Harold P. Gruney, of St. Louis. Wings fold back over fuselage as shown

FLOAT attached under fuselage, and pontoons over wheels, make Pfc. George Schreiter's plane an amphibian

METAL FRAME supports power unit in the bonded plywood shell. By E. L. Goeck, Minneapolis

FLYING-WING amphibian has seats built into tips of wings. N. J. Pastour of Chicago



'Big Mo'

This is our mighty *Missouri*. With three other Iowa-class battleships now commissioned she will help deliver the knockout against the Japs in the Pacific.

Official U. S. Navy Photos

BIRD'S-EYE VIEW. Looking down on the bow during AA battle practice as a 40-mm. "quad" (quadruple antiaircraft mount) goes into action. The decks of the big battle-wagon fairly bristle with these "stingers." Air-defense officers and a lookout, whose binoculars are fixed on a handlebar mount, stand on a platform in foreground

MUFFLER. For protection from the weather, Fire Controlman 3rd Class James Tucker of Richeyville, Pa., adjusts a gun "bloomer." This heavy rubber cover fits at juncture of a 16-inch and the turret. This ounce of prevention helps to keep "Big Mo's" Sunday punchers in prime shape for the all-out battle against the enemy



CRASH! Triple blast from the *Missouri's* No. 1 turret spells death and destruction to the enemy as 16-inchers roar simultaneously. Water is churned up by fire from the newest addition to Uncle Sam's mighty seapower

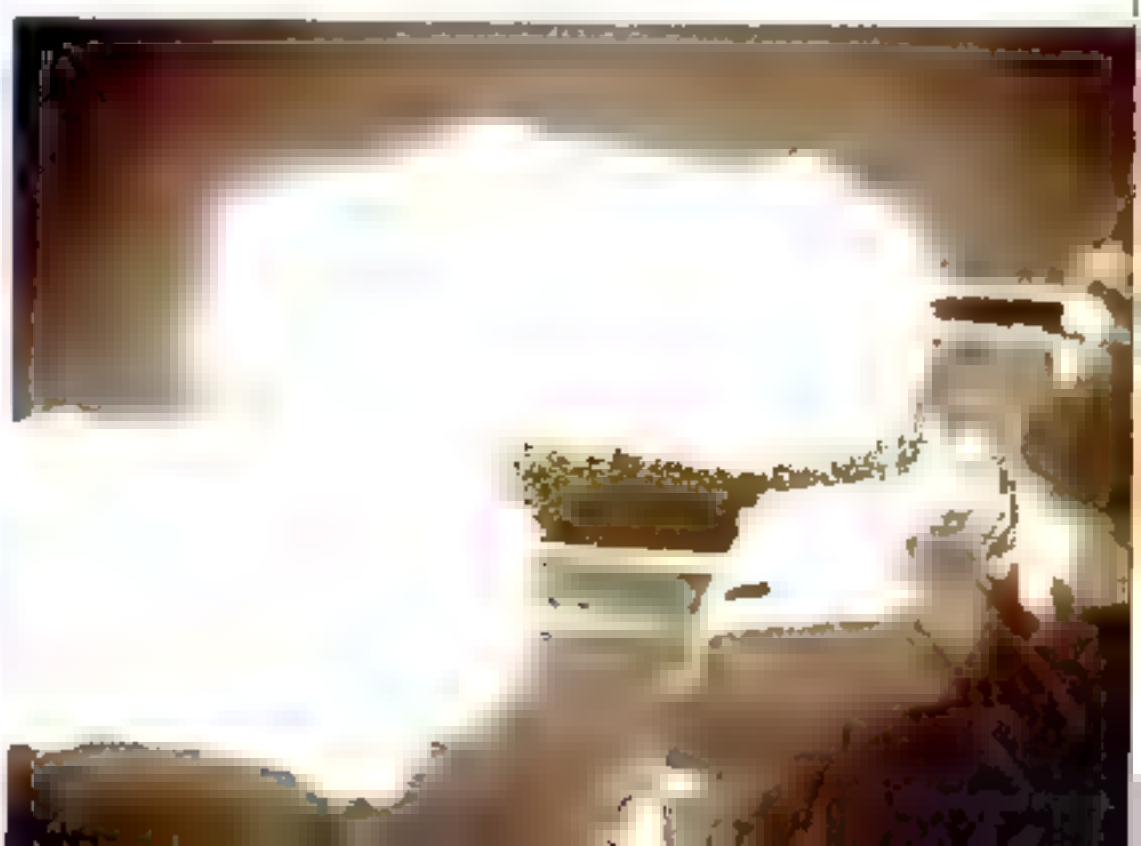


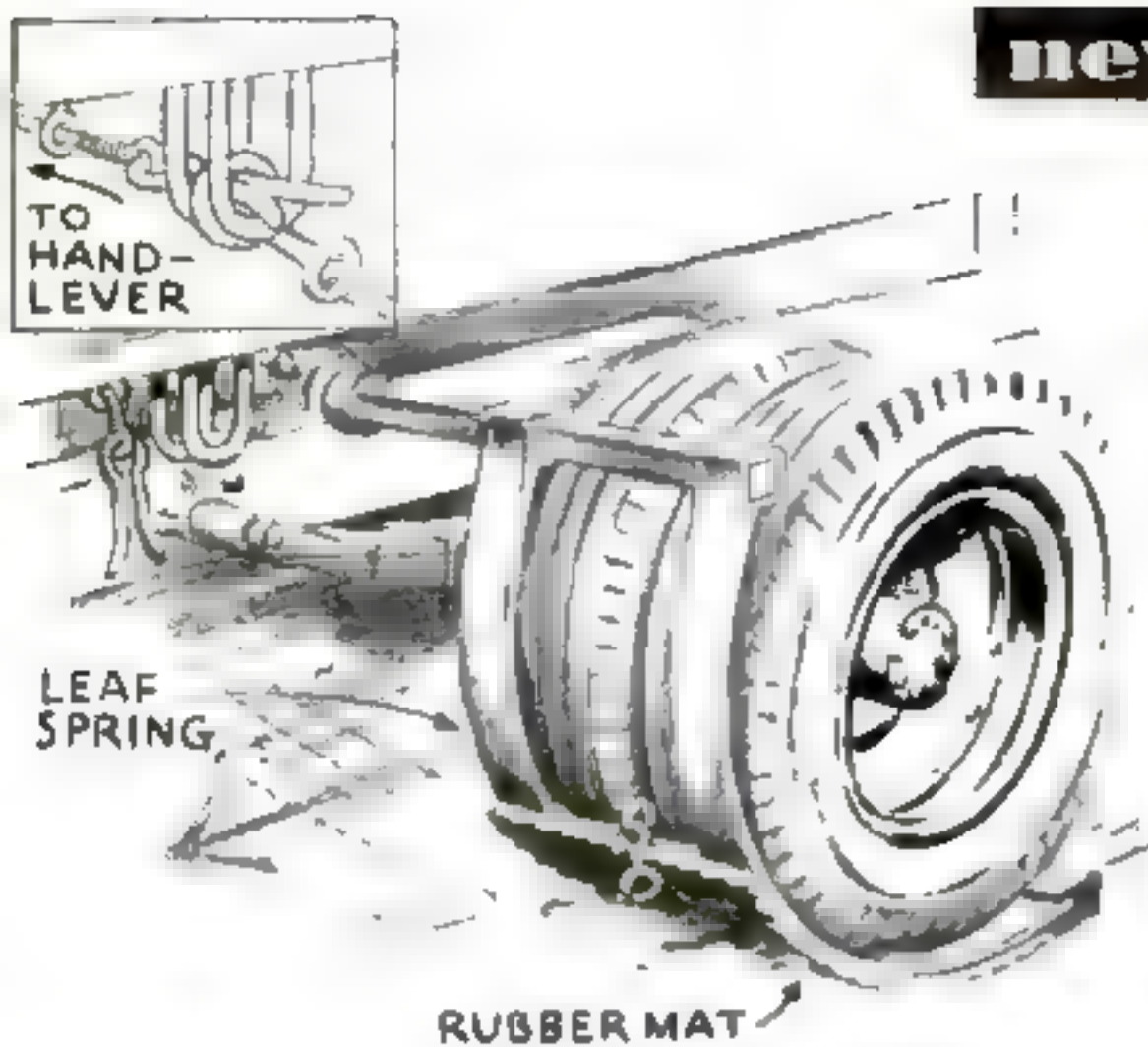


FIRING In a spectacular burst of flaming gases, the center guns of the two forward 16-inch turrets send out their 2,400-pound shells. The guns in action are elevated for long range. The powder charges needed to fire these monsters of destruction are contained in bags of purest silk, which burns to the last shred and leaves no smoldering spark that might pre-ignite the next load. Firing a single 16-inch gun consumes the equivalent of 300 pairs of silk stockings. The six 16-inchers pictured are two thirds of the main battery

ORDERS. Comdr. Jacob E. Cooper, USN, the executive officer, passes an order to his "talker," Seaman 2nd Class Vincent Domino, on the open bridge during gunnery practice. Domino transmits the order by battle telephone to turrets and fire-control stations

FLASH! Five-inch guns of the secondary battery fire at night and light up the ship with a brilliant glare. The crack of these guns rivals even that of their big brothers, the powerful 16-inch rifles. Twenty of them are ranged along the *Missouri's* sides in two levels of twin mounts, and the dual-purpose guns are effective against air and surface targets

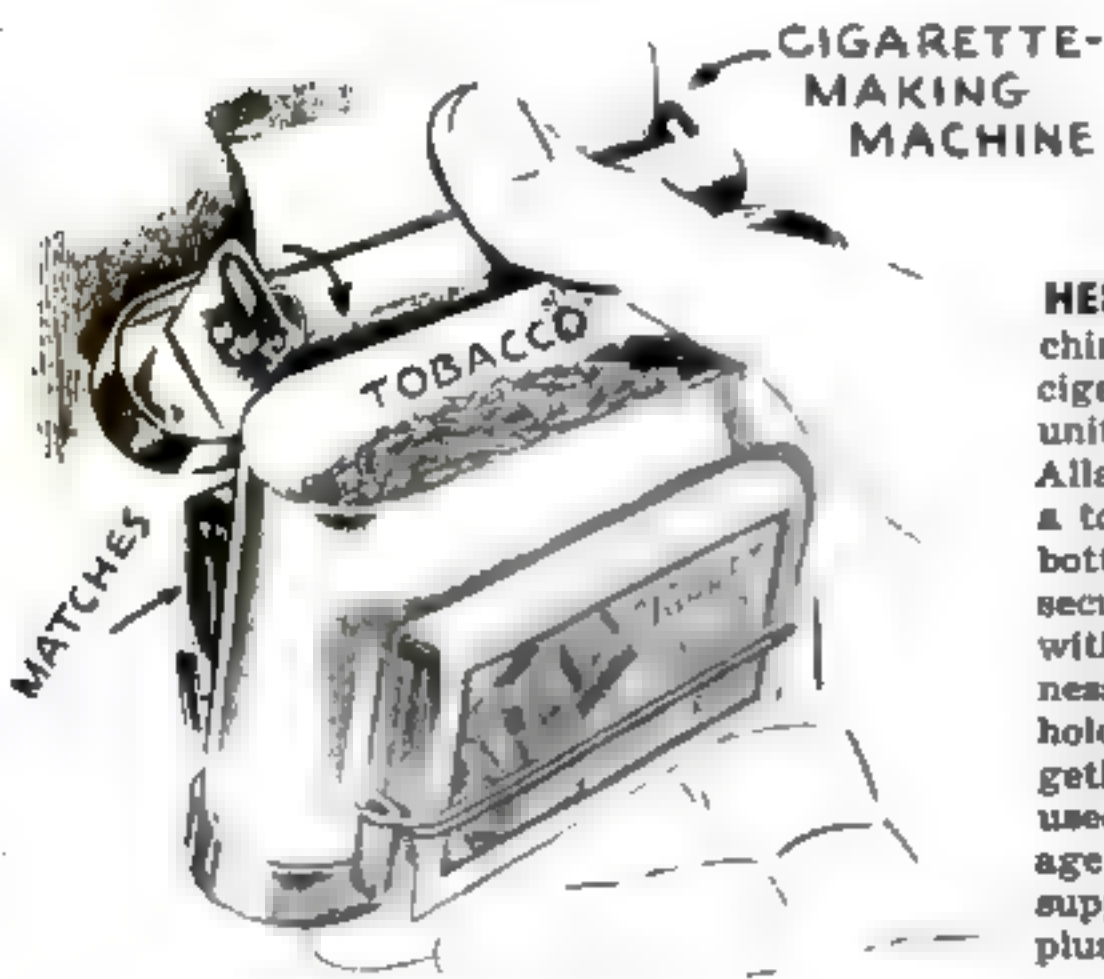
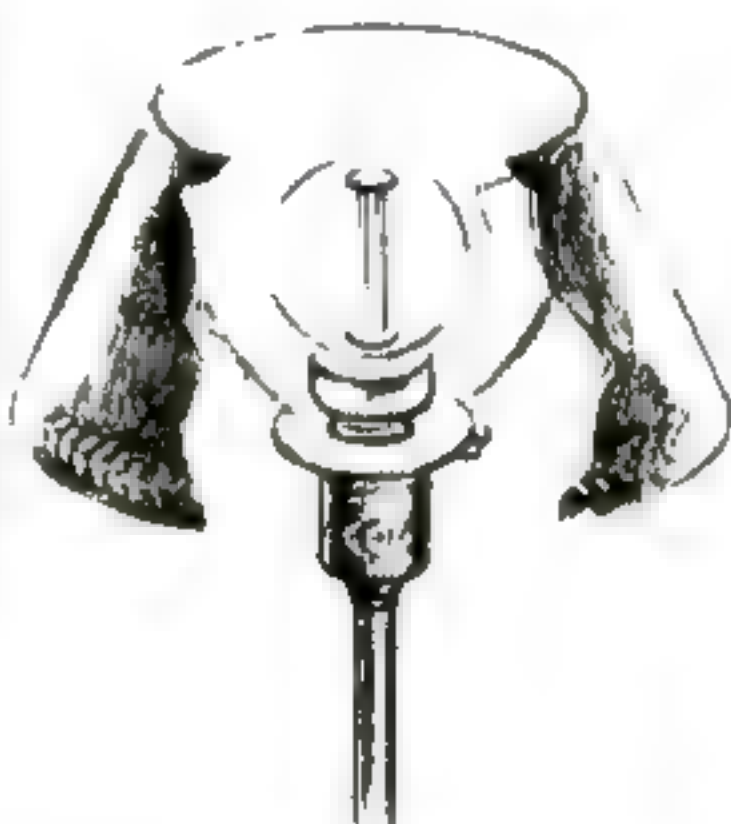




NEW BRAKE CLUTCHES ROAD

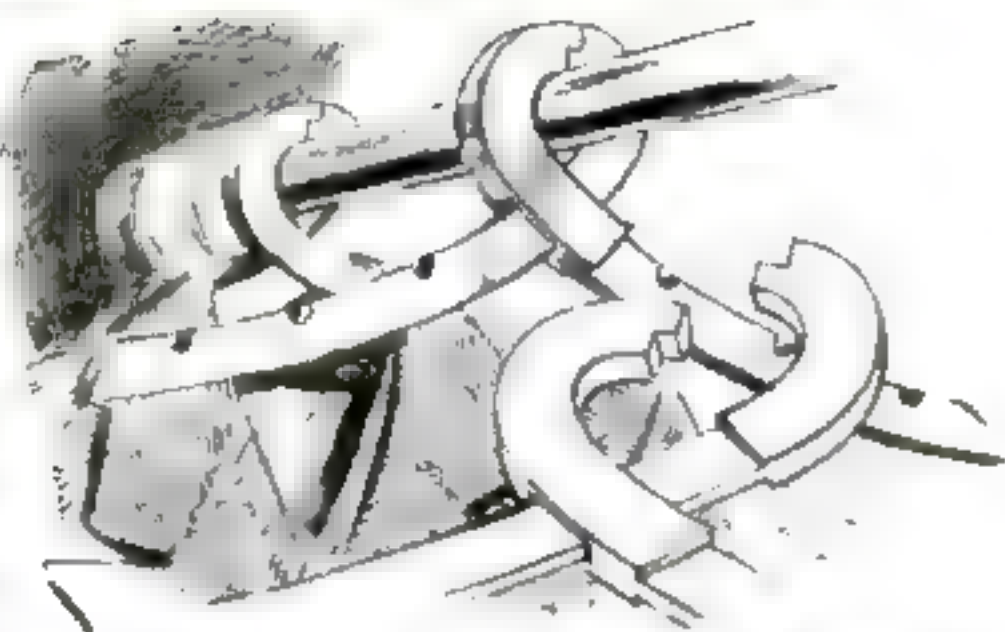
when lowered in front of rear wheels, which roll upon it to a standstill and drag the apronlike pad on the pavement. Designed as an emergency brake, this invention by Arch Robert Jackson, Shavertown, Pa., supplements the regular brake equipment standard on motor cars. It consists of arc-shaped leaf springs to which is secured a rubber mat, the bottom surface of which is corrugated to provide friction on the pavement. For use on icy road surfaces in winter, calks are provided, extending through the rubber. A special hand lever beside the driver controls the raising and lowering of the brakes through cables extending to transverse bars that hold the mats ready in position.

FLUORESCENT HOME LIGHTING may be made available through a small spherical lamp devised by Jefferson E. Gates, Jacksonville, Fla. Unlike the system used in commercial and public establishments, it involves no unusual expense of installation, since the new lamp is provided with a specially designed adapter for attaching to conventional light sockets and for housing the necessary ballast and starter units. The lamp may be easily disengaged for replacement without the adapter's having to be removed from the socket. As with other fluorescent lights, the heating coil must be energized before the bulb can be lighted.

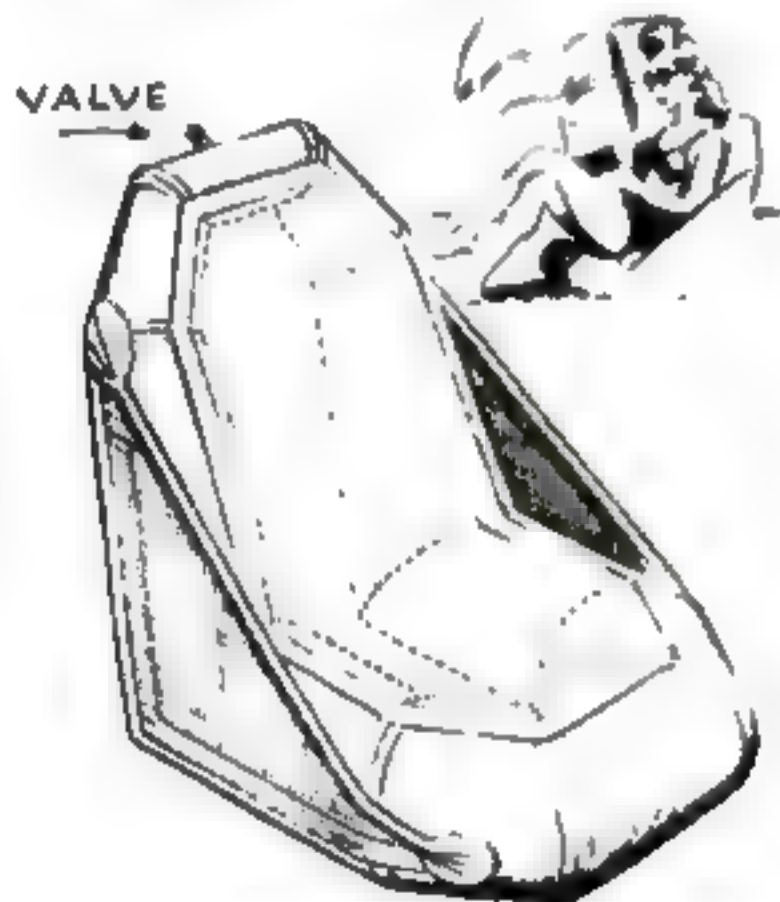


HERE ARE THE "MAKINGS" and a machine to fashion them into well-tailored cigarettes, all contained in one pocket-sized unit. The outfit was originated by Maurice Alland, of Los Angeles, Calif. It consists of a tobacco can containing a humidifier in the bottom, while on the inside of the lid is secured a clever device for rolling cigarettes with almost professional dexterity and neatness. There is also provision on the can for holding a supply of cigarette papers, together with fancy tips or tips that can be used as snuffers, to say nothing of a package of paper matches. All the user needs to supply in addition is a minimum of effort, plus the habit.

the inventors



PINCER COAT HANGER holds clothing safely, and may be made entirely of wood, plastic, or other composition. Constructed in two interlocking parts, so designed that their leverage establishes a firm grip on the supporting hook or rod, the hanger is easily disassembled for packing. It was invented by Osborne L. Horton, of Baltimore, Md.



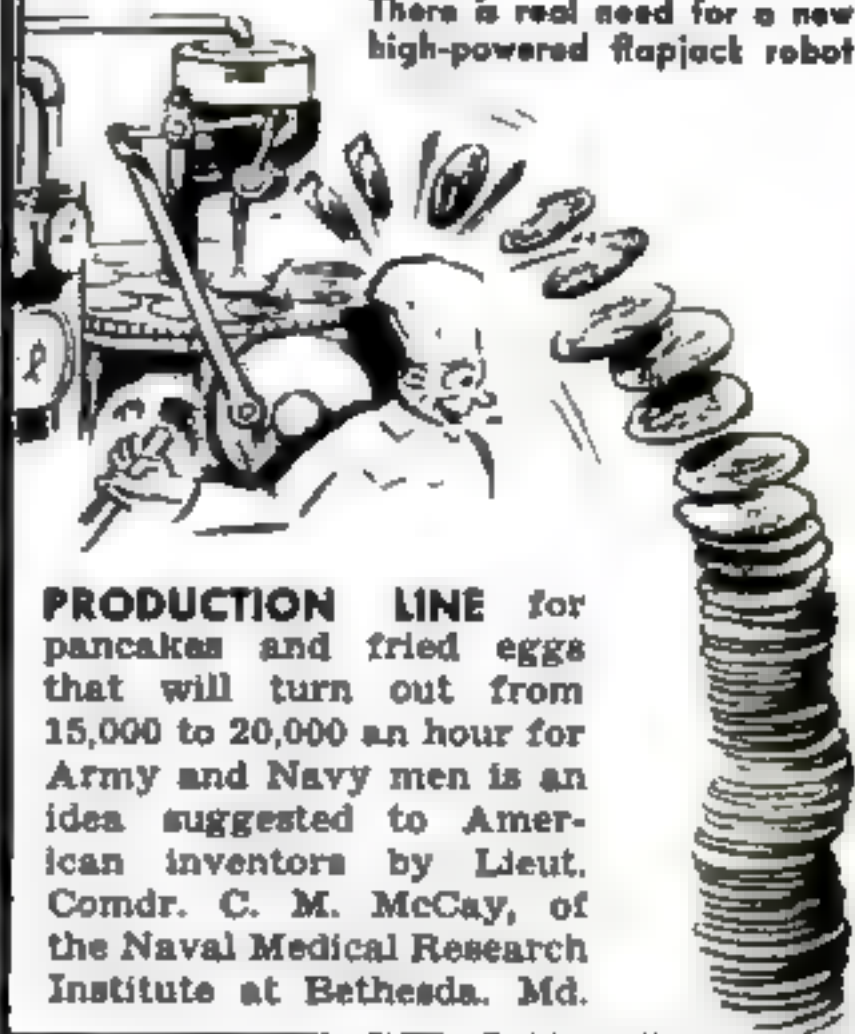
AN INFLATABLE CHAIR to provide comfort on beaches, lawns, shipboard, airplanes, or motor vehicles is a device originated by Kenneth Graeme Hann, Cyncoed, Wales. The chair form is made of suitable fabric or other material, inside of which is arranged a series of rubber tubes equipped with one or more valves for either lung or pump inflation. Side braces help to preserve the shape of the chair when it is in use, and additional tubes will raise it from the ground when a higher seat is desired. Aboard ship, it has the extra advantage of its potential value as a life preserver.

BABY GOES SKIING when there is snow on the ground if mother has a set of these sleigh-runner attachments for the carriage. The wheels fit into curved casings mounted on the runners, and are clamped by an easy operation. Adjustment means are provided for wheels varying in size, tread, and wheelbase. For rough or uneven ground, there is a separate runner for each individual wheel to obtain greater smoothness of going. When the runners are not required, they may be attached to the underside of the carriage. The invention is by Emanuel R. Morando, New York City.

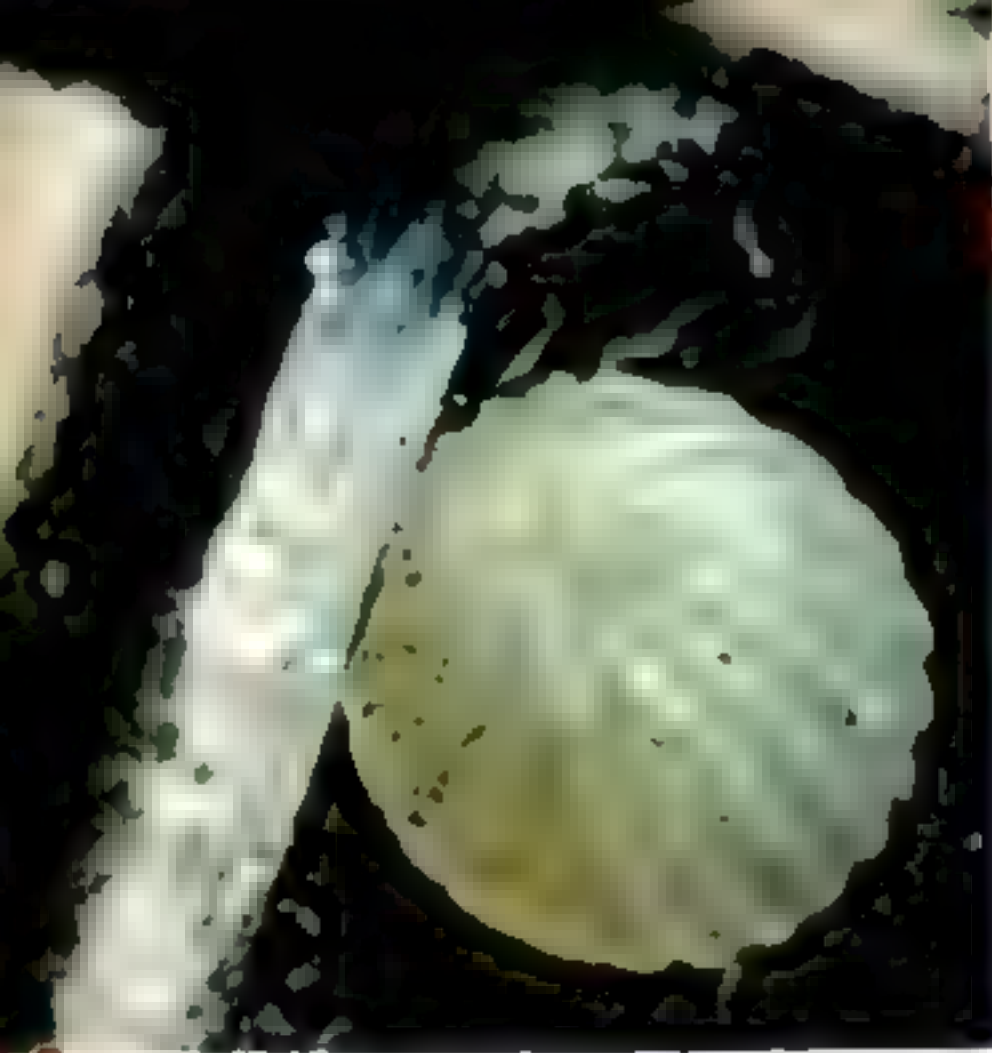


CALLING ALL INVENTORS!

There is real need for a new high-powered flapjack robot



PRODUCTION LINE for pancakes and fried eggs that will turn out from 15,000 to 20,000 an hour for Army and Navy men is an idea suggested to American inventors by Lieut. Comdr. C. M. McCay, of the Naval Medical Research Institute at Bethesda, Md.



Monarch butterfly egg (highly magnified) on underside of a milkweed leaf

LIFE CYCLE OF OUR Migrating Butterfly

The brilliant Monarch flies from the Gulf to Canada as it feeds on sprouting milkweed.

HERE is the life cycle of the familiar Monarch butterfly, told in a new and remarkable series of Kodachromes by Corydon M. Grafton, noted amateur photographer, of Norwalk, Conn. These are typical examples of the results he obtains by special techniques of his own devising

(P.S.M., Feb '45 p 100.) The Monarch migrates between the north and south with the changing seasons. Some butterflies live to complete the round trip. When a traveling swarm alights to rest, bare tree branches appear covered with foliage. The prolific Monarch raises several broods a year.



Showy colors of adult Monarch are protection against its being eaten by the birds, for they advertise its unsavory flavor. Other, more tasty butterflies take advantage of this by mimicking the coloration of Monarchs

Monarch caterpillar, when it has grown long and plump, turns into a chrysalis, the pupa stage of a butterfly. It hangs itself from a twig with a silk button, and acquires a green shell spotted with gold. Later the chrysalis becomes semitransparent, and, finally splitting, releases the butterfly





Teardrops of excess coating are removed from dipped article by action of high-voltage grid

ELECTRICITY SMOOTHS PAINT

PAINT "tears" are drops that hang from pieces that have been coated by dipping. A method for "de-tearing" such objects electrostatically has been devised by the Harper J. Ransburg Company's electric-coating division, Indianapolis, Ind. The coated article, with accumulation of excess material at drain-off points, is electrically freed from this excess after the dipping operation, and then goes into the baking oven to acquire a uniform finish. The article is carried over a high-voltage conducting grid that exerts strongest force at prominences.

Without benefit of the electrostatic field, the cylinder (at left center) is sprayed on only one side



With the current switched on, the same spray, during the same period of time, completely coats cylinder



"DE-TEARING"



1 Tears drip off an ornamental bracket ready for treatment



2 Electrostatic attraction removes tears when grid is "on"



3 Same piece de-teared. Even surface requires no hand work

ARMY-NAVY CLOCK

HOURS

BLACK MINUTES INDICATE
RADIO SILENCE

intervals

SHIP'S CLOCK

6 WATCHES OF 4 HRS.
MAKE DAY OF 24 HRS.
(BELLS SOUND EVERY 1/2 HR.)

MILITARY TIME

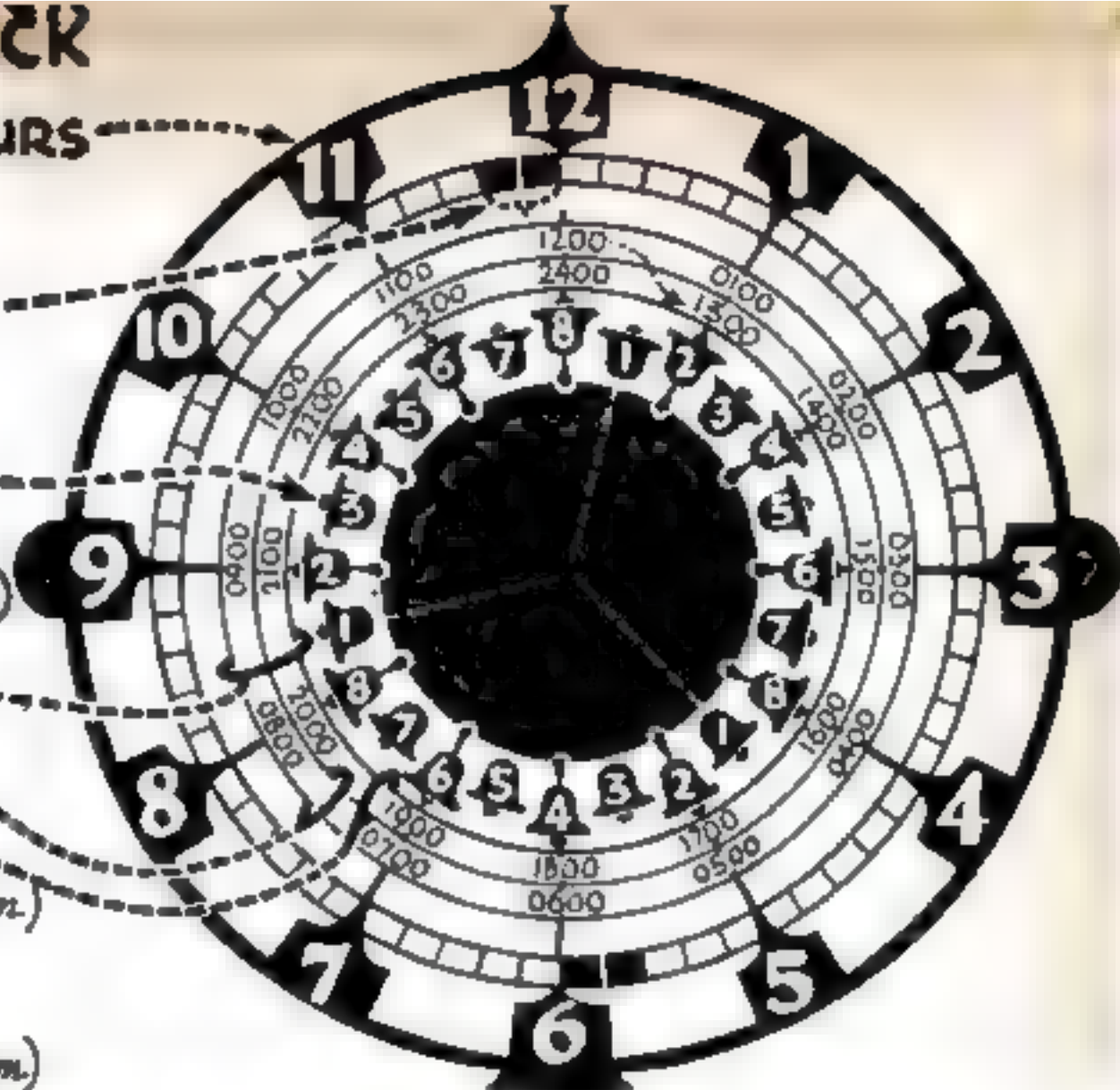
AM MIDNIGHT to NOON

PM NOON to MIDNIGHT

(0302 = 2 MINUTES PAST 3 a.m.)

HR. MIN.

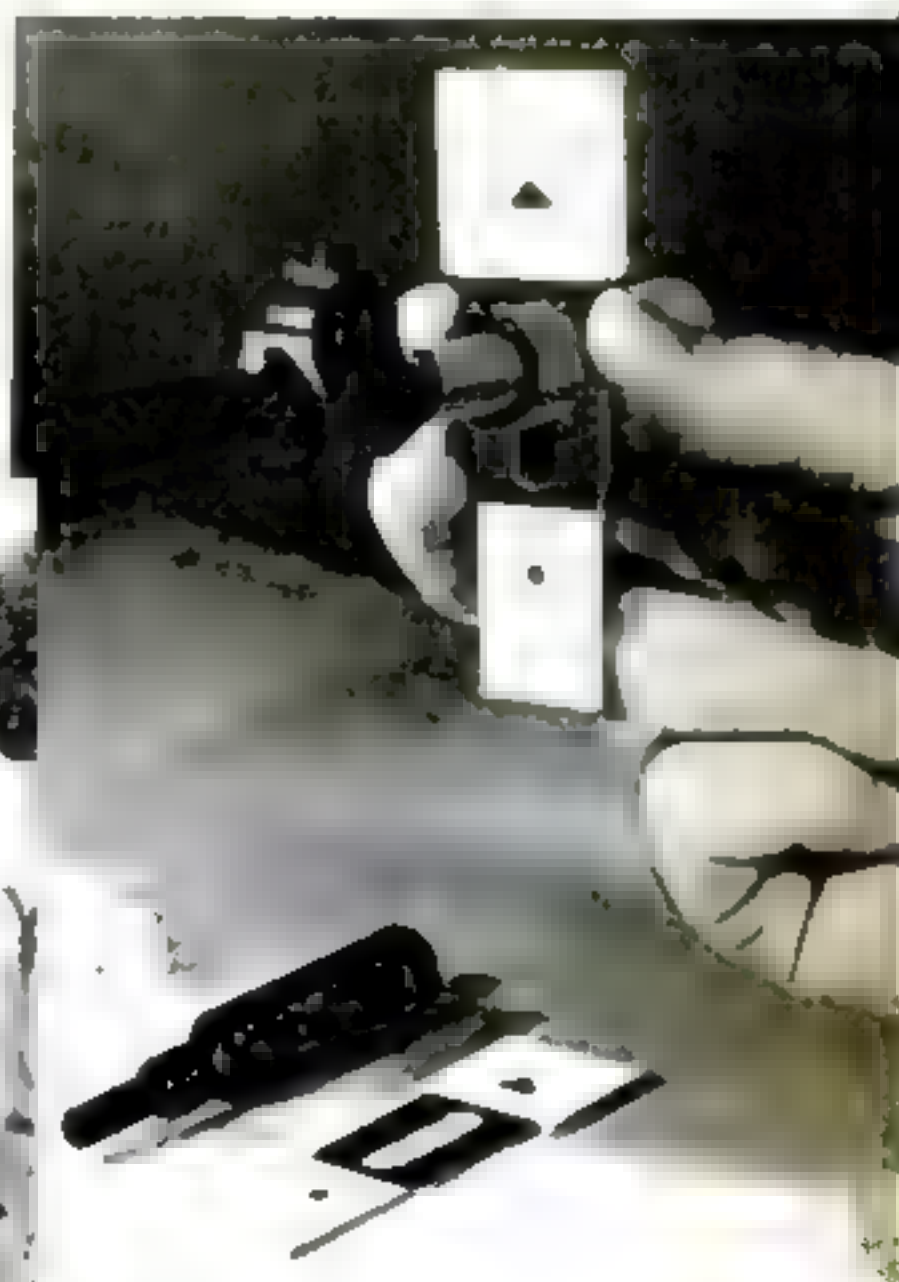
(1747 = 47 MINUTES PAST 5 p.m.)



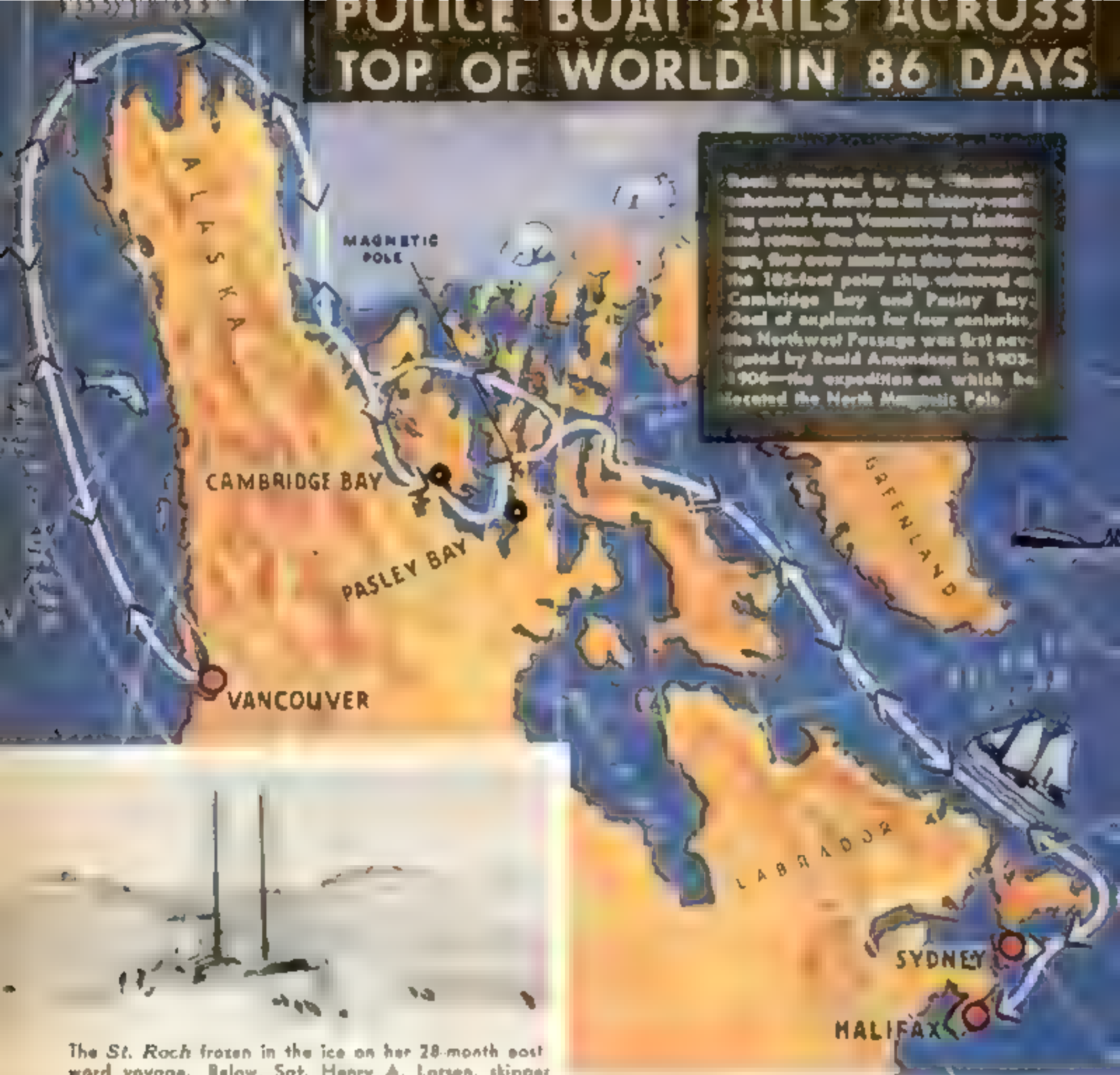
STUDY the accompanying clock face, and you'll be able to tell time by ships' bells and by the 24-hour military system. First, it explains the six watches of Navy time. The bell, ringing from one to eight times, sounds every half hour during each four-hour watch. Odd-number strokes always mean half-past the hour. In military time, also used on teletype air reports and radio

control, the first two digits indicate the hour, and the second two digits the minutes; 0720 is 7:20. Add 12 to a.m. figures to obtain the corresponding p.m. time. Thus, 1920 is 20 minutes past 19, or 7:20 p.m. The black minute spaces just before the hour and half hour indicate two-minute periods of radio silence, designed to allow weak distress signals to be picked up.

BULL'S-EYE TRAINING. A ■■■ Instructional Sighting Device makes it possible for the marksmanship pupil to aim at a target, then hand the rifle to his instructor and be checked for accuracy. A movable target is attached to the end of the rifle and adjusted to conform to what the pupil believes is the correct aim. Then the instructor, by aiming the rifle, finds how close the pupil came. The device is made by Paige Training Aids, of New York City.



POLICE BOAT SAILS ACROSS TOP OF WORLD IN 86 DAYS



The *St. Roch* frozen in the ice on her 28-month eastward voyage. Below, Sgt. Henry A. Larsen, skipper



BLAZING a trail for future commercial navigation across the top of North America, the Canadian Northwest Mounted Police schooner *St. Roch* last summer completed the first round trip ever made through the Northwest Passage.

Starting at Vancouver B.C., in 1940, the specially constructed polar ship made the pioneer west-to-east passage to Halifax, N.S., in 28 months, spending two winters locked in the ice. The return trip was made in one season—86 days from Sydney to Vancouver.

Equipped with sails and a Diesel auxiliary engine the polar police boat has a top speed of six knots.

Staff Sergeant Henry A. Larsen, skipper of the *St. Roch*, says that small wooden vessels can go through the Northwest Passage in a summer. His own ship has timbering two thirds heavier than normal, copper sheathing and an outside covering of Australian ironbark to resist crunching ice.



CHRONOGRAPH MEASURES MUZZLE VELOCITY OF SHELLS FROM BIG GUNS

Drawing by E. G. SEIELSTAD

③ CYCLE COUNTER AND INDICATOR.

CYCLE COUNTER TOTALS AND INDICATES NUMBER OF CYCLES FROM FIRST SIGNAL TO SECOND SIGNAL. TIME INTERVAL ELAPSED WHILE PROJECTILE TRAVELS FROM A TO B IS INDICATED BY BANK OF LIGHTS TO 1/100,000 SECOND.

COIL GENERATES SECOND SIGNAL TO CHRONOGRAPH

CYCLE COUNTER FIRST SIGNAL TO CHRONOGRAPH

② ELECTRONIC SWITCH.

AT FIRST SIGNAL ELECTRONIC SWITCH TURNS ON AND ALLOWS 100,000 PER SECOND CYCLES TO FLOW. AT SECOND SIGNAL IT TURNS OFF.

① SIGNAL-SHAPING AND AMPLIFYING CIRCUIT.

FEEDBACK INCOMING CURRENTS ARE BROUGHT UP TO A USABLE MAGNITUDE. SHAPE OF SIGNAL IS CHANGED TO OPERATE SWITCH.

OSCILLATOR.

(TIME STANDARD)
SOURCE OF CONSTANT 100,000 CYCLES PER SECOND CURRENT

LIGHT-BANK INDICATOR

TRIGGER

FIRST SIGNAL

SECOND SIGNAL

TIME INTERVAL TO BE MEASURED

How fast a shell leaves a gun's muzzle now is determined by superfast chronographs at the Aberdeen, Md., proving ground. Suitable for testing projectiles from weapons of any size, they help to perfect guns and ammunition, and to compute firing tables used by U. S. gun crews. First mag-

netized, the shell is fired through two coils suspended a known distance apart. Each passage generates an electrical signal. Between signals, an electronic device called a cycle counter totals the number of electric impulses from an oscillator, which delivers 100,000 a second.



We Move the **EARTH** *for* **COPPER**

From spears to dive bombers, it has always been a prime necessity of war. How America is supplying the vast needs of today.

By HAL BORLAND

IF IT hadn't been for a spring freshet in a Utah canyon, the Japs might still be holding a strategic Pacific island from which, instead, our bombers are now operating. That freshet leached copper sulphate from the stripping dumps of a copper mine, and from that sulphate was recovered copper vital to the dive bombers that cleared the way for our forces. By such margins are battles, and even wars, won.

A strategic metal, copper not only alloys our bronze and all the duralumin in our war-planes; it provides the nerve systems for our motors, our automatic controls, our radar, and other electrical equipment. Fortunately, we do not have to depend on leach-

ings from mine dumps for the bulk of our copper; but war needs have so strained our production that even minor sources are important.

Copper is the only metal ever found abundantly in nature in a pure state. Long before the white men came, American Indians were mining it along the south shore of Lake Superior—copper so pure it could be hammered into tools and ornaments just as it came from the ground. In 1857 a pure copper mass of more than 400 tons was found in those mines, which have now been worked more than four centuries. What pure copper is left in them, however, today is found only as a veining of cementing material in a conglomerate rock.

To find America's copper now you must

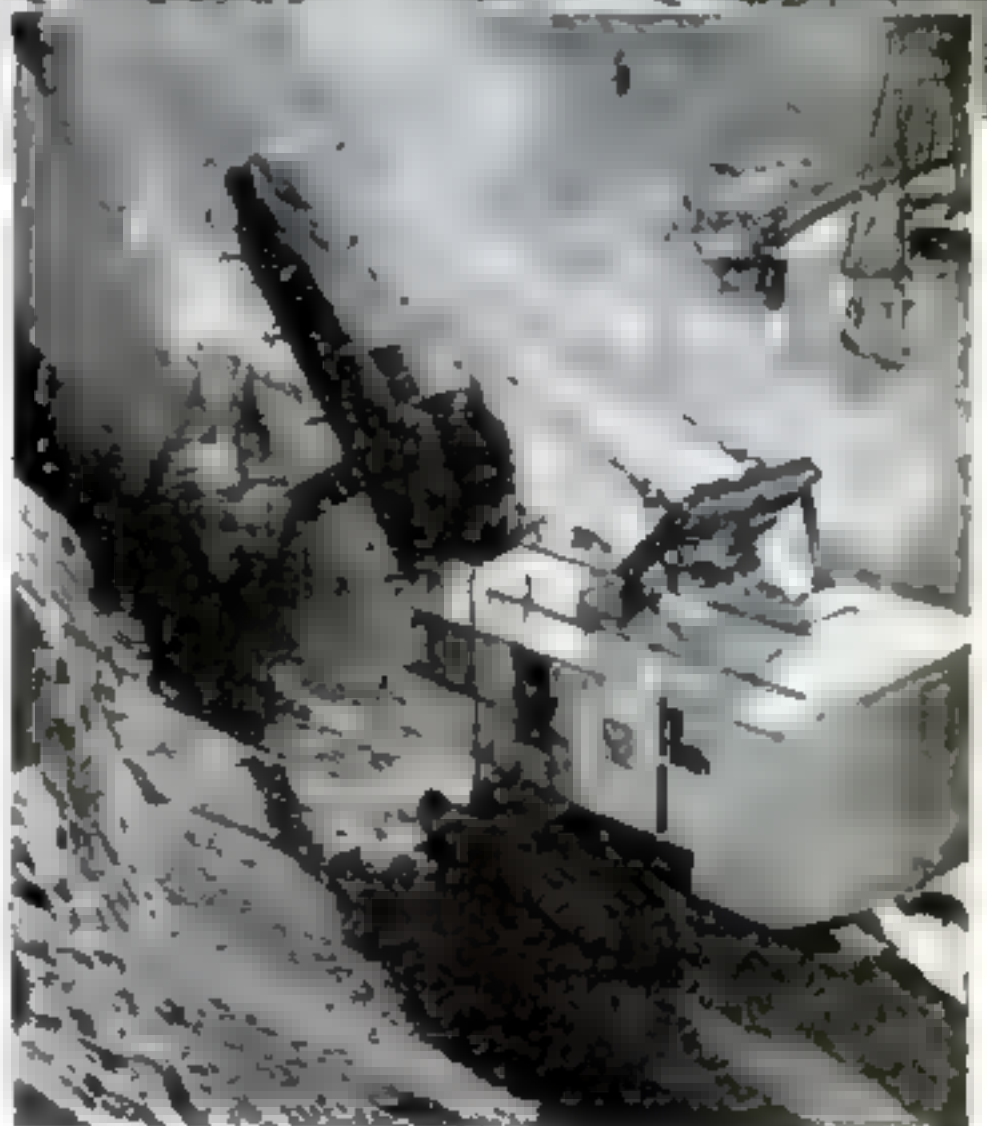


Largest in the world is the Bingham Canyon open-cut copper mine located 30 miles southwest of Salt Lake City. In operation since 1904, it has yielded some six billion pounds of copper

wander all over the map and into mines which produce a considerable variety of copper ores. Principally, copper comes from Arizona, Montana, Michigan, Utah, Nevada, and New Mexico, but a dozen other states ranging from Tennessee to South Dakota are also producers. As pyrite, malachite, cuprite, chalcocite, and azurite, the ore comes from shafts a mile deep and from man-made canyons open to the sky. From these ores the copper is extracted by crushing, washing, concentrating, smelting, and electrolytic action. Silver is copper's only rival as a conductor of electricity. Iron is the only metal used more extensively than copper.

The biggest of all copper mines, both in area worked and in ore handled, is that of the Utah Copper Company, at Bingham Canyon, in the Oquirrh Mountains about 30 miles southwest of Salt Lake City. An open-cut mine, it looks like the Yale Bowl grown to gigantic proportions—a bowl more than a mile and a half across, brink to brink, and nearly 2,000 feet deep.

The ore that comes from this mine is, in the geologist's words, a monzonite porphyry



One of Bingham's 41 caterpillar-mounted electric shovels scoops up a five-cubic-yard mouthful of loose ore preparatory to dumping it into one of the cars in the background. Ore is blasted loose 1,500 tons at a crack

containing finely disseminated sulphides. There are also minute quantities of gold, silver, and molybdenum in the ore, some quantities of which are recovered. Although the molybdenum content is scarcely more than a trace, so much ore is handled that this copper mine is also the second largest producer of molybdenum in the world.

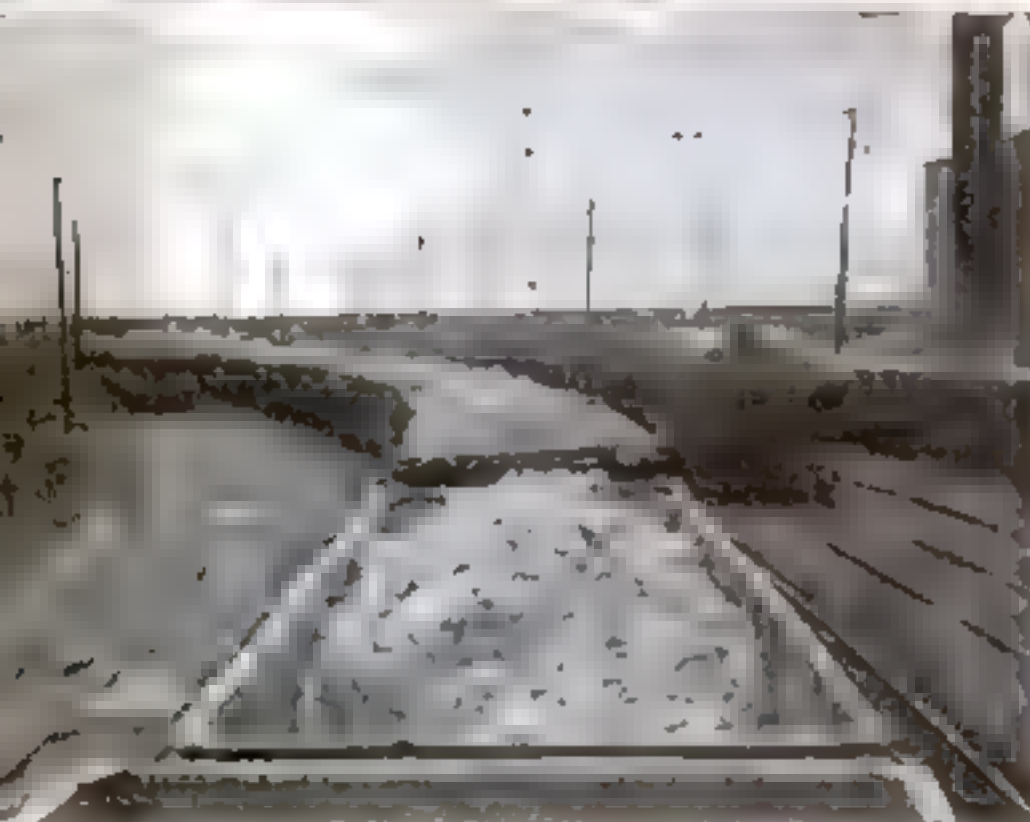
Open-cut mining is essentially a job of earth moving. It consists simply of scooping away surface soil and debris, breaking up the ore beneath, and moving the ore to the concentrating plant. At Bingham Canyon the principal mining equipment includes such things as 41 caterpillar-mounted power shovels, each of which can handle five cubic yards at a scoop; 115 miles of electrified standard-gauge railroad track that coils around the 20-odd benches of the pit; hundreds of ore cars and dump cars, dozens of

big electric locomotives, over 150 miles of high-tension power and trolley lines, and a fleet of bulldozers.

Stand on the brink of the pit and you will see a scene so huge that the activity of 2,000 workmen is virtually lost. Look a little closer and you will see a shovel at work on a bench across the way. Then another, and another. You count them and tally up more than 30, most of them looking like toys. Trains creep around the benches—one, two, a dozen, even more trains than shovels; and they, too, are almost lost in the immensity of the operation. Benches that look like seat tiers in the Yale Bowl are 65 feet high and 100 feet wide, and each bench has its railroad track, its overhead power line, its working space for a power shovel.

Whistles scream, and the echoes bounce back and forth within the canyon. The

REFINEMENT BY FLOTATION, SMELTING, AND ELECTROLYSIS

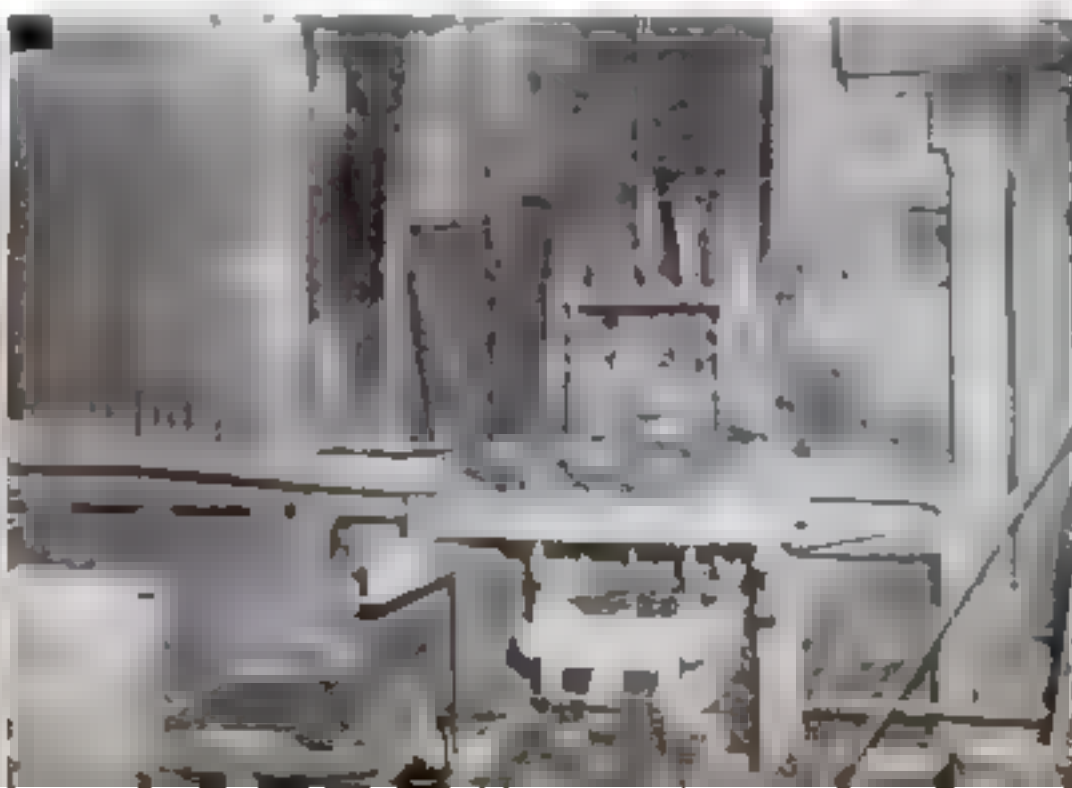


1 Trainload of Montana ore rolls into the yards of the Anaconda Reduction Works at Anaconda, Mont. Like Utah ore, it has low copper content

2 The first step in refining the low-grade ore is to grind it up into small pieces in a gyratory crusher so as to break the copper ore loose from the waste rock

5 Now a comparatively rich concentrate, the ore is dumped into a big converter and cooked until molten. At this stage it is known as "blister copper"

6 Final refinement comes with electrolysis, for which copper must be made into anode slabs (at top). From anodes, mineral is carried to pure-copper cathodes



COPPER

U. S. DEPOSITS IN ORDER OF YIELD

WORLD PRODUCTION
1943

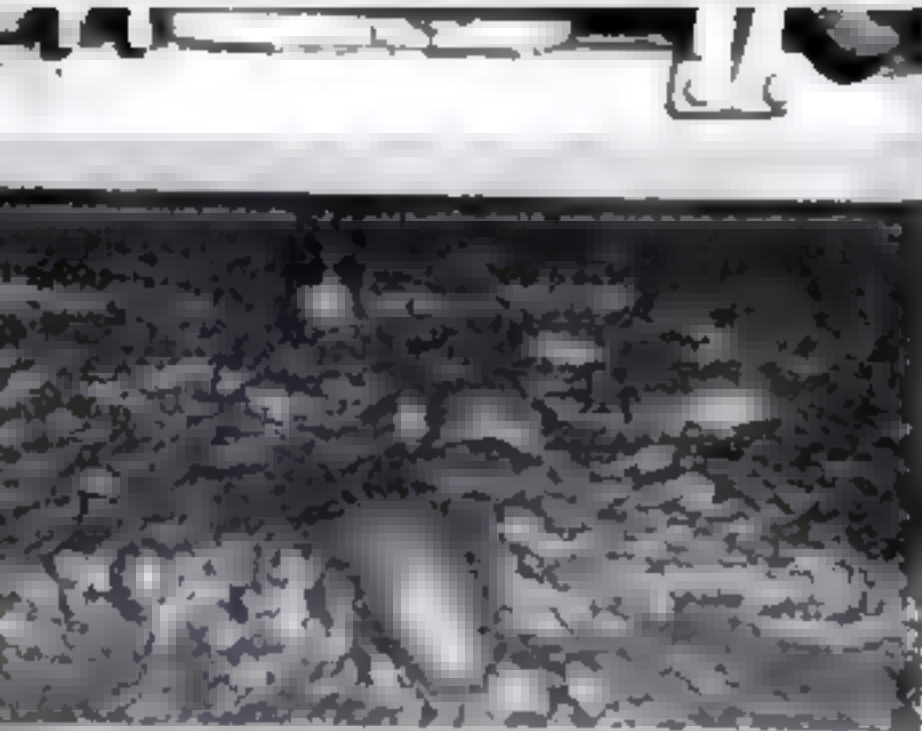
1. ARIZONA
2. UTAH
3. MONTANA

4. NEVADA
5. NEW MEXICO
6. MICHIGAN

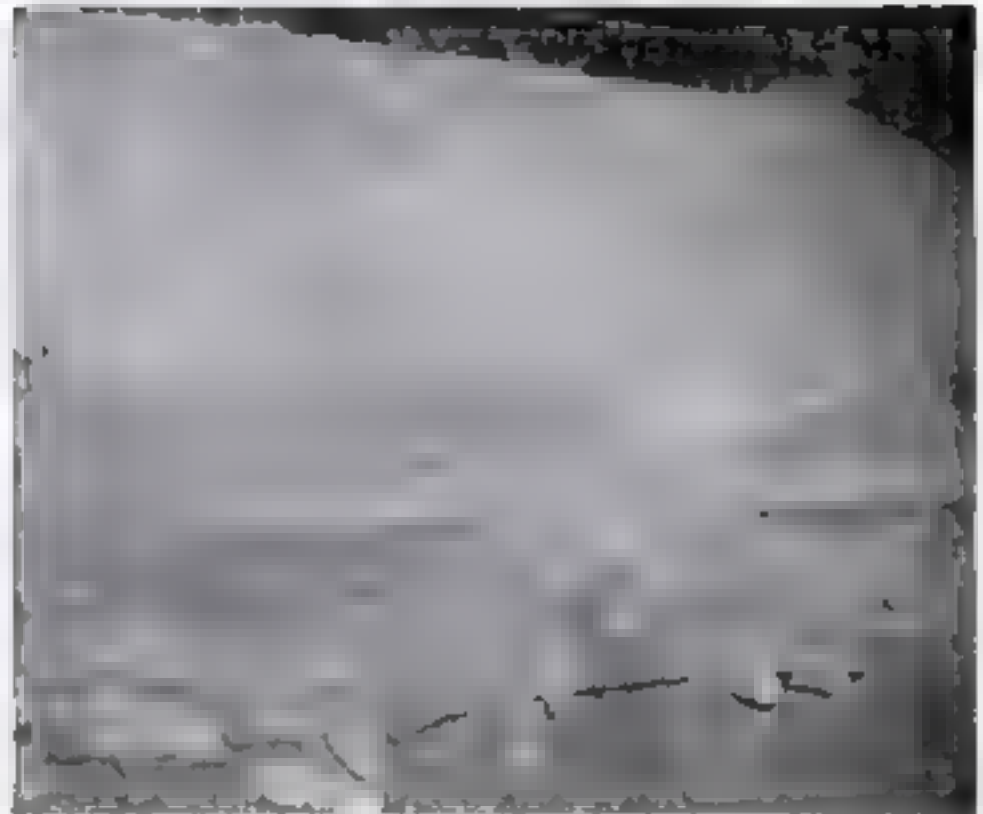


		MILLIONS OF TONS
U. S.		1.11
CHILE		.55
CANADA		.29
GERMANY		negligible
REST OF WORLD		1.13

PRODUCES AN ALMOST PURE COPPER FROM LOW-GRADE ORE



3 After a sifting process, the ore is dumped into a water-and-chemical solution from which copper-rich ore is skimmed off the top



4 Dipping into the ore, a huge drum picks it up on its sides as it turns and then forces air through the ore. When it is dry, the ore peels off in sheets

7 These cathodes, representing accumulations of copper 99.97 percent pure, await hot-water bath that will rinse off the electrolyte



8 Cast into ingots, copper awaits shipment to war plants where it will be fashioned into nerves and sinews for tanks, planes, ships, and other weapons



signal means that drillers have driven blast holes into the toe of a bench and are about to set off their powder charges. There is a dull rumble and a dust cloud rises. About 1,500 tons of ore are loosened with each charge set off. The shovels move up and the trains move in. Foot by foot, the levels are gnawed back. Ton by ton, the ore is scooped out and hauled to the concentrating plants 18 miles away. Pound by pound, the copper comes from the earth.

The stripping dumps are an additional source of recovery. Topsoil, waste, and ore too low-grade to concentrate are hauled by rail to gulches cutting the walls of the canyon below and beyond the mine. In these dumps, the small fractions of copper sulphides become oxidized into copper sulphate, which is water-soluble. Rains filtering through the dumps leach out the sulphates in the form of copper-sulphate solution. This run-off is trapped behind catch dams and piped to a precipitation plant where the solution runs through long vats containing shredded detinned cans. There, by a chemical replacement process, the copper and the shredded iron of the cans change places so that the copper is deposited in the bottom of the vats and the iron goes out in solution in the water. So simple and efficient is this recovery that pipe lines now sprinkle the dumps periodically to supplement the rain and melting snows and thus keep the leaching process in constant operation.

The porphyry ores of Bingham Canyon show none of the brilliant colors the layman usually expects in copper minerals. These ores are a light granite gray, with the occasional glitter of iron pyrites, or "fool's gold." For the spectacularly beautiful ores, such as azurite and malachite, one turns to Arizona, where these blue and green copper

carbonates are relatively plentiful, particularly around Bisbee. But the bulk of America's copper today comes from ores that would not especially delight the colorist, ores that even the early copper miners would have ignored.

It was native copper, of course, that man first used, copper that was found either in its pure state or in natural alloys. Objects made of such copper and alloys have been found in Egyptian remains dating as far back as 4700 B.C. And a considerable variety of both copper and bronze objects has been recovered from excavations of Mycenaean, Phoenician, Babylonian, and Assyrian civilizations of as early as 1800 B.C. The Egyptians probably obtained their copper from the Sinai Peninsula, and the early Greeks and Romans got theirs from Cyprus, which gave the metal both its name and its chemical symbol.

Here in America the early French explorers heard Indian tales of copper deposits around the Great Lakes, but no one worked those deposits extensively until about 1845. Early in the eighteenth century, however, copper ore was mined in Connecticut, New Jersey, and Pennsylvania, and attempts were made to smelt it. The venture had little success, but a few shipments of the ore were sent to Europe.

All through colonial years copper was an important metal, but not a major metal industrially. It was worked primarily by coppersmiths, of whom Paul Revere, who was also a silversmith, was one of the most outstanding. It was he who made the copper and brass fittings for the warship *Constitution*. At about that time he wrote to a friend that "no man but myself in the four New England States can melt the copper and draw it into spikes," and that he "could

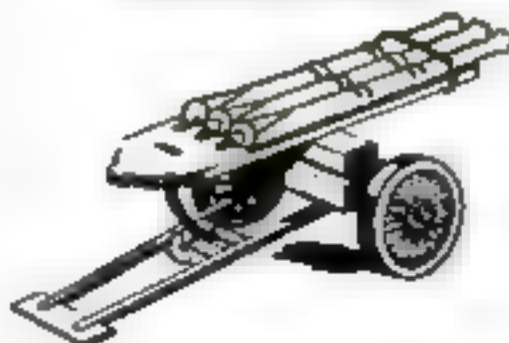
COPPER

DOWN THROUGH THE AGES



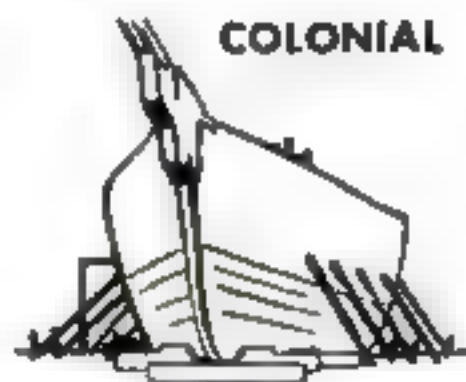
ANCIENT

Objects made of native copper have been discovered in ancient remains that date back as far as 4700 B.C.



MIDDLE AGES

This conception by Da Vinci of a bronze triple-bore fieldpiece paved the way for today's breech-loading guns



COLONIAL

Paul Revere and other coppersmiths made copper and brass fittings for ships, and rolled sheets to cover their hulls

COPPER

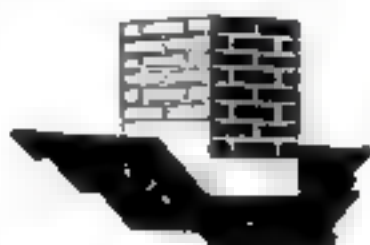
AT WAR AND IN INDUSTRY

ELECTRICAL EQUIPMENT



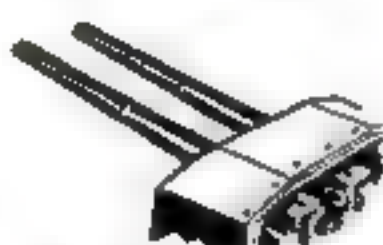
Switches, bus bars, contacts, and wiring demand vast amounts

BUILDING



Rust resistance makes it tops for flashings, gutters, and plumbing

WARSHIPS



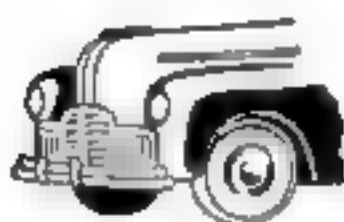
More than 225 tons go into one destroyer. Think of the losses!

PLANES



A fighter requires a half ton; a Flying Fortress, 2 1/2 tons!

AUTOMOBILES



Radiators take a lot of copper; more goes into wiring, alloys

LIGHT AND POWER LINES



Its high conductivity leaves it unrivaled as a current carrier

SHELLS



Soft rotating bands of copper give them their spinning flight

MEDICINE



"Copperplating" is a treatment now used for "athlete's foot"

make copper so malleable as to hammer it hot." In 1809 he rolled the plates from which a boiler was made for one of Robert Fulton's steamboats.

But copper did not really come into its own until the opening of the Great Lakes mines and, not long after, the rise of the electrical industry. And it is an interesting point that while copper serves electricity so well, electricity provides the best means of refining copper.

There are three principal ways of handling copper ores. The carbonates and oxides are first treated in a blast furnace. The sulphide ores are roasted, worked in a reverberatory furnace, and finally put through a converter resembling a Bessemer. Ores with only small fractions of copper are crushed, sifted, and concentrated by flotation, in which oil and water are added to the ore, the rock sinks, and the desired ore particles are held suspended in the froth of oil and water. From the blast furnace comes a copper concentrate known as matte. From the converter comes blister copper. And from the flotation process comes a concentrate which is also smelted into blister copper. Both the matte and the blister copper, however, are refined electrolytically.

This final step calls for using the blister-copper slabs as anodes in tanks of copper sulphate solution. Pure copper sheets are used as cathodes, and direct-current electricity is passed through the solution. Pure

copper is transferred electrolytically from the anodes to the cathodes, and the impurities in the original slabs collect as a sludge, from which by-products are recovered. The pure copper deposited on the cathodes is then ready to be melted down, cast in bars, and formed for its final use.

Although silver is a better electrical conductor than copper, its relative rarity and its high price remove it from competition. It is being used to a limited extent now for special purposes—as heavy bus bars, for instance—but only on "loan" from the United States Treasury to release copper for more critical needs. (P. S. M., July '44, p. 122.) This emergency substitution will not continue beyond the duration of the war.

No one has ever found an adequate substitute for copper, and there are no indications that one will be found in the near future. If one were in sight, even for use only in the electrical field, the hard-pressed Germans, who have turned to nearly every substitute in the book, would be using it. But captured German material still shows copper, brass, and bronze being used in critical places, and no important substitutions for copper in electrical equipment. Germany has met its copper shortage by stripping civilian life. For copper remains king in its own broad and varied field, particularly as the nerve system for the electrical apparatus which is indispensable in modern war machines.

WORLD'S BIGGEST



Surplus war goods to be sold by the Government include many things you'll be able to use around your home, in your work and hobbies.

COULD you use a pair of paratroopers' snowshoes? And don't say "no" too quickly, because you may soon have a chance to buy them at a throw-away price from some store dealing in surplus war goods.

At first glance, you'd say that their only value would be for sportsmen in the far north, or boys who want to go snowshoeing for fun. When the first batch of snowshoes was offered for sale by the Government, however, a bright designer of novelty goods snapped them up. All he did was to add short wooden legs and a glass top to each. He then sold them as small cocktail tables.

It took still more imagination to find a use for a lot of officers' rowelless spurs left

over from World War I, which turned up recently in a warehouse. One manufacturer converted some of them into ornaments for horsey ash trays. The remainder went to the promotion manager of a children's Wild West radio show, who distributed them as premiums. But what can be done with 100,000 hand-grenade aprons, now awaiting disposal, or flashlight cases without tops, or firing pins for heavy artillery, or wagon singletrees and axles?

Vast quantities of war goods of this nature will go on sale shortly. If you put your wits to work, you will be able to find good use for some of the items in your home, in your workshop if you have one, or

SOME OF THE GOODS THE GOVERNMENT PLANS TO SELL

FOR THE HOME

- Air-conditioning units
- Bells, chimes, gongs
- Brooms
- Brushes
- Clocks
- Cutlery
- Electrical appliances
- Fire extinguishers
- Floor coverings
- Furniture
- Glassware
- Heating equipment
- House furnishings
- Ice refrigeration units
- Lamps
- Lamp shades
- Lanterns
- Laundry equipment
- Lighting fixtures
- Lockers

Abstract—This paper reports on a study of the effects of a 10-week, 12-session, group-based, self-help, cognitive-behavioral intervention on the self-reported health status of 100 people with chronic low back pain. The intervention was designed to help people with chronic low back pain to manage their pain and improve their self-reported health status. The intervention was based on the principles of cognitive-behavioral therapy and was delivered by a group of trained facilitators. The results of the study showed that the intervention had a significant positive effect on the self-reported health status of the participants. The intervention was found to be effective in reducing the pain and improving the self-reported health status of the participants. The results of the study suggest that the intervention may be a useful tool for the management of chronic low back pain.

Mirrors
 Musical instruments
 Phonographs
 Pillows
 Plumbing equipment
 Pottery
 Ranges
 Radio sets
 Recreation equipment
 Shelving
 Spring scales
 Tablers
 Taxis
 Water coolers

FOR THE SHOP

Ammunition chests and boxes
 Aprons
 Cabinets and chests
 Quacks
 Grinding wheels

Planned work

- Hardware
- Insect screens
- Ladders
- Machine tools
- Nails, screws, bolts, rivets, etc.
- Paintbrushes

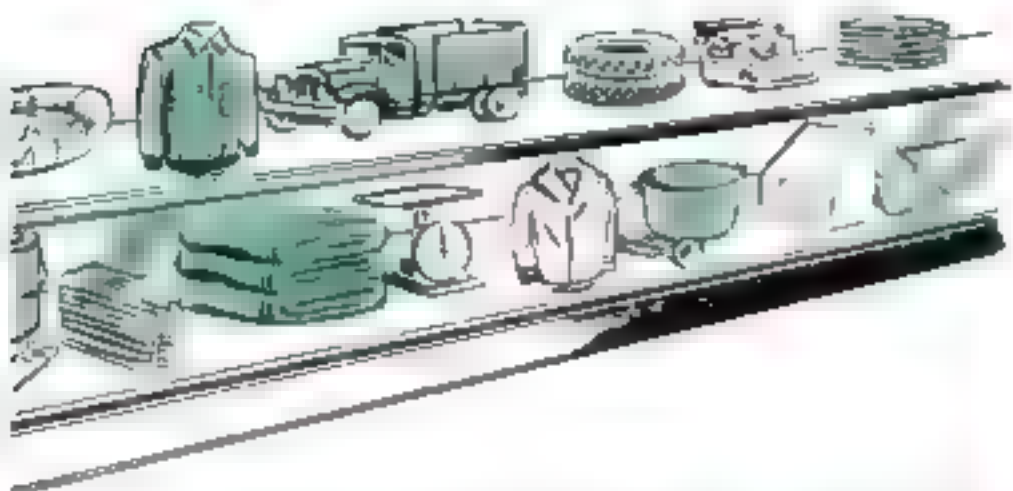
FOR THE FARM

Agricultural machinery
 Appliance supplies
 Dairyman's supplies
 Farm implements
 Fence wire
 Harness
 Lamps
 Live animals
 Footman's supplies
 Storage batteries
 Tractors
 Trailers
 Trucks

FOR OUTDOORS

- Airplane
- Ammunition
- Belt
- Bicycle
- Boat
- Boys
- Corridor jumps
- Floor
- Jump
- Meatballs
- Pack
- Rail
- Shoe
- Sleeping bag
- Small arms
- Snowshoe
- Sporting goods
- Tank
- Tire
- Trooper
- Weapon

BARGAIN COUNTER



in connection with your sports or hobbies. To take a single item, the familiar mosquito bar may be put to many uses. The Office of Surplus Property, Treasury Department Procurement Division, which is in charge of the disposal of most of the consumers' goods in which the average man or woman is interested, has addressed a letter to the buyers of department and sporting-goods stores in which it is pointed out that these nets, which are 30 inches wide, 74 long, and 39 high, and are available in considerable numbers, may be used in civilian life for converting a cot or glider on the back porch into a sleeping room, for covering a baby bed or carriage in the yard, and for making an outdoor playhouse for small children. They will protect Boy Scouts from insects on *(Continued on page 807)*

Cash Prize Contest \$200 for the best letters on

"HOW I'LL USE SURPLUS WAR GOODS"

OF ALL the surplus war material which is now becoming available for civilian use, what would you most like to own? How would you use it? For letters from readers suggesting the most ingenious and valuable ideas, POPULAR SCIENCE MONTHLY will make the following awards:

FIRST PRIZE	\$100
SECOND PRIZE	50
THIRD PRIZE	25
FIVE PRIZES, \$5 EACH	25
TOTAL	\$200

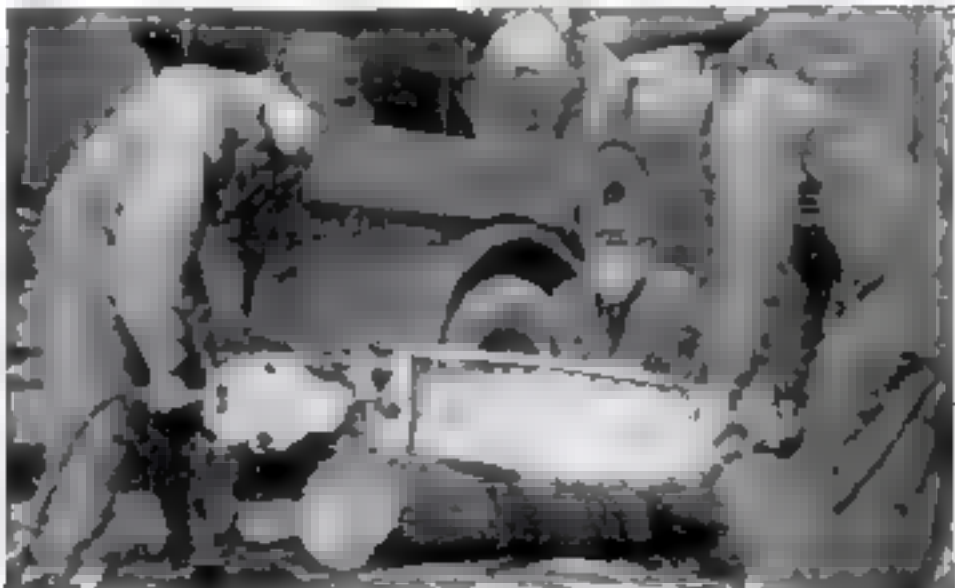
Put your wits to work and write a letter of not more than 250 words telling what it is you want and why you want it. In case of a tie, both contestants will be awarded the prize tied for. Address the Postwar Idea Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y., and mail it on or before March 31, 1945.



INSECTICIDE BOMB should prove a boon to housewives and also around the farm



ASSAULT BOATS . . . CHAIN SAWS. Outdoorsmen will find a choice of equipment for both work and play



WHY JAPAN CAN'T WIN ON LAND

The Nips are doomed when they meet us in the open. Their tanks and guns can't match ours.

By GOLD V. SANDERS

Photographs by WILLIAM W. MORRIS

Drawings by STEWART ROUSE

WHEN MacArthur's invading infantrymen broke away from the Lingayen beachheads into the valleys of central Luzon, they started a new and decisive phase of the land war in the Pacific. Now, at last, we had the Japs in the open where we could get at them with the weight and power of our superior armor and guns. We knew what the result would be, from a cold-blooded comparison of their weapons with ours. We have captured Japanese war equipment of all kinds; our ordnance experts have studied it and found it second-rate, or worse.

The Japs are the world's most brazen copycats. Nobody knows this better than our specialists whose duty it is to examine and test their weapons of war. These experts will also tell you that the Japs are not even good at copying. However assiduously they attempt to duplicate a good weapon of another power, they never succeed in equaling it in quality and performance. In outward appearance their version may look like an exact copy of the original, but closer examination reveals crude workmanship and a low standard of dimension tolerances. Actual testing shows up the defects to be expected from such workmanship and engineering.

So we know now that our guns outperform and outrange theirs by a wide margin in every category, from shoulder rifles to the biggest field guns. We know that our tanks outclass theirs to such an extent that there is hardly a basis for comparison. All our machinery of war is more reliable because it is well made to close tolerances. Our ammunition

is more powerful, more uniform, and more accurate.

All of this will be spelled out in piled-up Jap bodies and smashed equipment when the final battles of World War II are fought on the expansive terrain of China—they will be, according to our military experts. Up to now, our all-around superiority in weapons has not been fully demonstrated because the Japs have called all the shots. The Japs started the war, and in the first stages they determined where it would be fought—in the jungles. For such warfare they were comparatively well armed. Their shorter-ranged rifles and guns, their many mortars and howitzers were well adapted to this type of in-fighting. They have given us a lot of punishment in the clinches, but now we have learned how to beat them even at their own game. Now we are forcing the fight. We are driving them slowly but surely out of the terrain they chose. In the final rounds they will have to trade punches with us in the center of the ring.

With what can they stop our mighty tanks when that time comes? Their biggest tank gun is a feeble 57-mm. affair of relatively short range and low hitting power. It is carried by their so-called medium

tank, which looks like a relic from World War I. Its armor is less than half as thick as that of our light and medium tanks. Such armor and such guns will be faced by our high-velocity 75's, 90's, 105's and such. Our Sherman tanks, with their 75-mm. guns, smashed their tanks to pieces on Saipan and Peleliu—a small sample of what will happen if the Japs try to meet us in a major tank battle.

Up to now, the Japs have not shown up with bazookas, though this is

Here's the Score:

ORIGINALITY

What little there is of it is of poor quality. Best original Jap designs are in mortars.

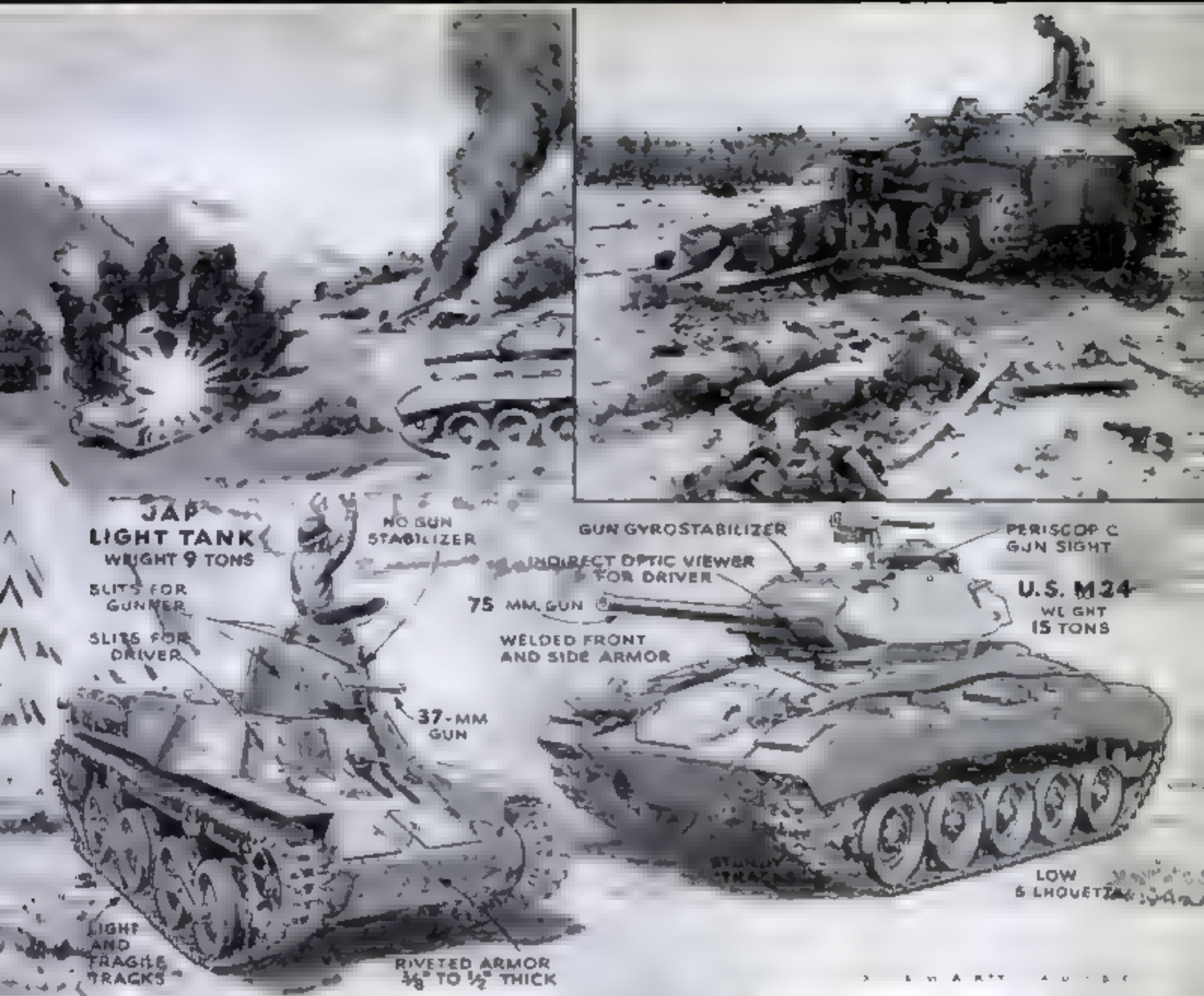
COPIES

Even when the Nips imitate weapons of the western powers, they do a bad job, owing to low standards of manufacture.

DUPLICATION

Lack of standardization of weapons and ammunition creates confusion and complicates the supply problem.

JAPAN'S BEST TANKS ARE NO MATCH FOR OURS



U.S. ARMY GUIDE

ORIGINAL DESIGNS ARE FEW...AND INFERIOR

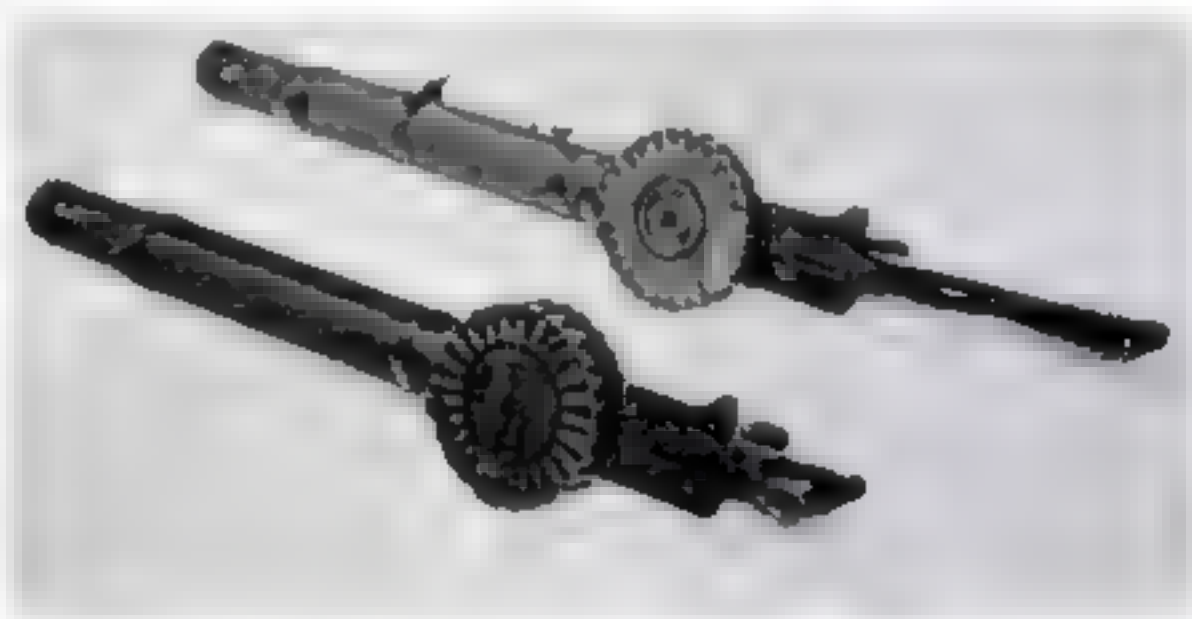
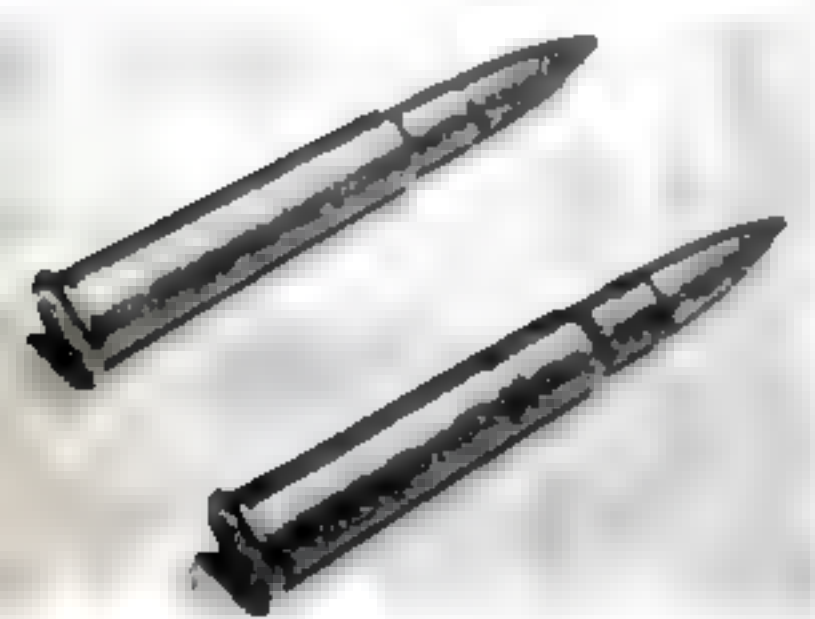
90-MM. MORTAR has two hydraulic recoil cylinders that let the barrel drop back about six inches when it is fired. In later models this idea has been abandoned

ANTITANK GUN. The Jap idea of what it takes to stop a tank (in foreground) is contrasted here with the mammoth German 88 Shells for the Nazi weapon (on stool) are almost as large as the barrel of the 47-mm. Nip gun





COPY OF U. S. BROWNING. Our .50 caliber aircraft machine gun, shown at left, was the pattern for this Jap weapon, which is used in naval planes. The Jap copy is one of the best of their guns we have captured. Jap naval weapons and ammunition are generally better than army counterparts

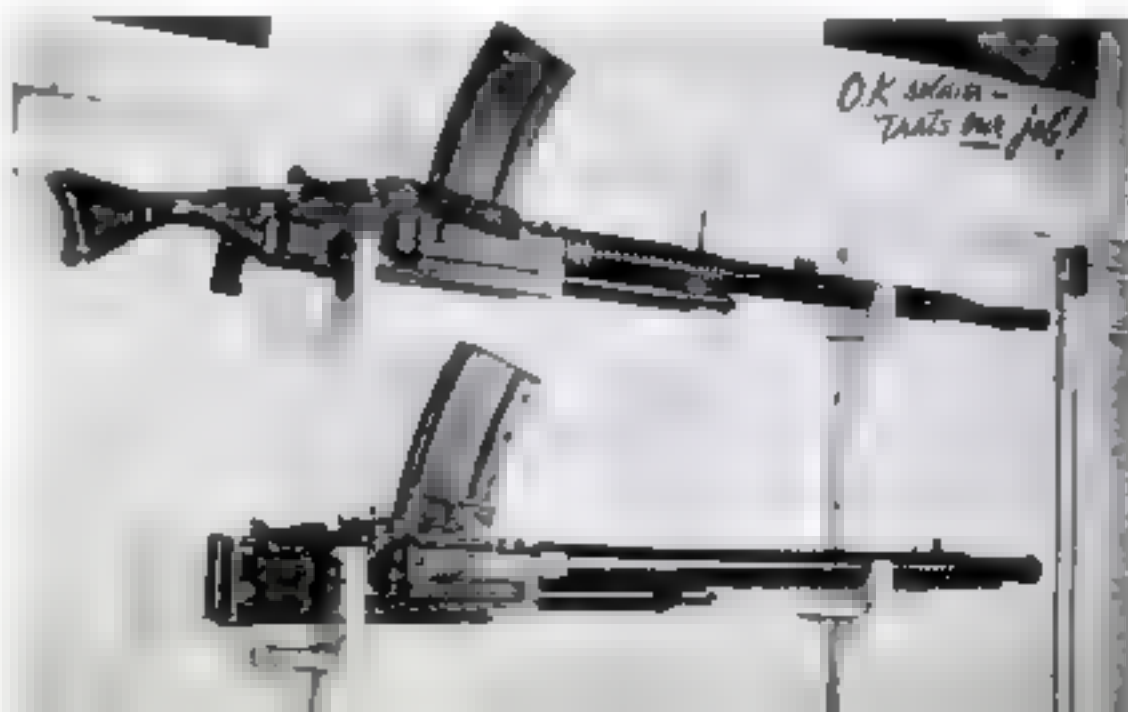


BRITISH LEWIS GUN, top right, was copied closely in the Jap machine gun shown beside it. Japs bought a few Lewises in the 30's, then made their own. At top left is Jap cartridge, with British original

a weapon which ought to be easily duplicated. It is considered likely that they will shortly be equipped with rocket launchers of this type, for they have already copied the explosive war head used by us and by the Germans. They are using it on their rifle grenades and cluster bombs dropped from planes. But the bazooka is also a short-range weapon, and they may find it hard to get close enough to use it against our tanks.

With what will the Japs counter our field artillery—the big guns that punched holes in the Siegfried line? They have fieldpieces in almost every category, but inferior ones. Their biggest is a 240-mm. howitzer, which has a maximum range of 11,000 yards. How will it stand up against our 240-mm. howitzer with a maximum range of 25,000 yards? Our 240 is an extremely mobile big gun and can be moved on only two vehicles at 30 miles an hour

ITALIAN BRED A 13.2-mm. machine gun (a little larger than our .50 caliber) also received the flattery of imitation by our Oriental friends. Top gun at right is the copy. The Nips use it as a ground gun and also for antiaircraft work, often in a dual mount. Ordnance men find it inferior to our Browning



THEIR COPIES FALL FAR BELOW THE ORIGINALS



FROM THE NAZIS the Japs copied a rifle grenade (bottom), including the "Munroe effect" tank-busting hollow charge (P.S.M., Feb. '45, p. 65)



GERMAN LUGER pistol reappears as the Jap Nambu. The resemblance is chiefly external. Nambu (top) is not a good gun; its ammunition is worse

and emplaced in a half hour or so. The Jap howitzer is broken up into ten vehicle loads for moving.

The longest-range gun the Japs have is their 150-mm., which throws its 89-pound projectile 22,000 yards. With this they will have to counter our 155-mm. Long Tom with a range of 25,000 or more, and our eight-inch gun with its terrific range of 35,000 yards. From here on down to the smallest-caliber fieldpieces, the story is much the same.

The best Japanese antiaircraft gun is a

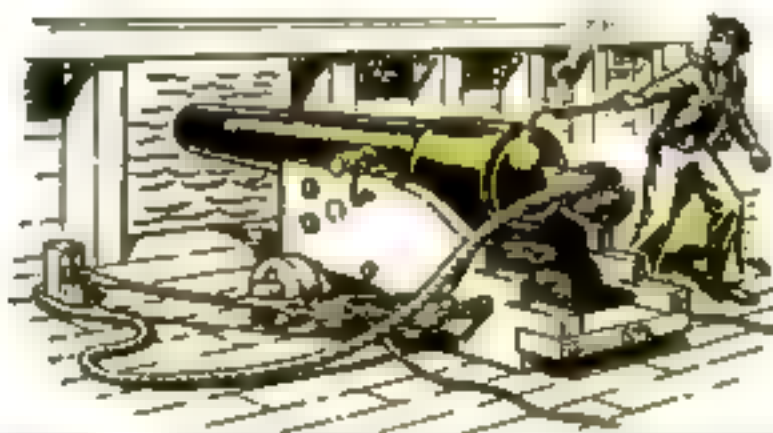
dual-purpose 120-mm., which they use against both planes and tanks. It is comparable to our 120, but its maximum ceiling is 35,000 feet against our 60,000, and its horizontal range 21,000 yards as against our 27,000. Ours can shoot up to 22 rounds per minute, theirs 12. Their gun has a mechanical director to compute firing data; ours has a marvelous electronic control (P.S.M., Sept. '44, p. 115).

Close study of Japanese war weapons on the whole shows clearly that they counted upon and prepared for a war at very close

THEY EVEN COPIED A U.S. GUN OF CIVIL WAR VINTAGE



JAP RIFLED MORTAR at right is more accurate than other mortars because of its rifled bore. As in our old Parrott gun, a band of soft metal at the base of the projectile is expanded in firing and grips the rifling of the barrel





RIFLES are supplied to Jap troops in two sizes: the old 6.5-mm. (about .25 caliber) at top, and the newer 7.7 (about .30 caliber). Older gun was long for bayonet use



CARTRIDGES for 6.5 (top) and 7.7-mm. rifles. Since guns of both sizes may be found in a single company, the supply problem is a headache. The 7.7's muzzle velocity is 2,300 feet per second, compared with 2,800 for U. S. service rifles

range. They went in for mortars of wide variety, and these have been murderous weapons in the kind of war they have been making all through the Pacific Islands. The graves of many American Marines and soldiers bear testimony to that.

So great has been the Japanese pre-occupation with mortars that they have actually shown some inventiveness in this field. They have at least nine varieties of trench mortars. The wicked little misnamed "knee mortar" was their own creation. Extremely light and simple, it throws a considerable load of death and destruction over the treetops at close range. Their largest mortar, the 90-mm. (3.5-inch) was the first produced with a recoil mechanism to steady it. In one mortar, the Japs devised a crude but effective method of controlling the range. This one has a slot near the base of the tube, which is opened and closed by varying degrees to permit escape of pressure. In still another, the Japs are making use of an American Civil War invention, the Parrott gun. This mortar is rifled. Its projectile has a copper band near the base which is expanded by the propelling charge so that it follows the rifling and thus obtains greater accuracy than is possible with a smoothbore.

Granting that the captured Japanese equipment is not the best they have now, or will have to use against us in the battles to come, what chance do they have to catch up with us in the armament race? A very slim one indeed, according to our intelligence reports. We know pretty well what they are doing, or trying to do, in this respect. Their greatly inferior productive capacity prevents their retooling

to turn out complicated machines of war, even when they have in their possession complete models from which to copy. It takes more time than they will be granted. Instead of catching up, they are falling farther behind all the time.

In their four months of fighting with Russian forces in Manchuria, back in 1939, the Japs found out that their artillery was woefully deficient and that their tanks were virtually useless. Since that time they have been hurrying desperately to make improvements. We know how well they have succeeded, and our ordnance experts say they have nothing we should fear. We are improving our weapons, too, and with a productive capacity 30 times as great as that of Japan, we are constantly widening the margin of our superiority. In a war to the death, the imitator is bound to lose, for he will never have a chance to copy the last great weapon that strikes him down.

How difficult it is for the Japs to produce a new weapon in large numbers is shown in the typical case of their service rifles. Since 1939 they have been substituting a larger-caliber gun, the 7.7-mm., for the old standard shoulder gun of 6.5-mm. caliber, that is, a .30 caliber for a .25. At this late date, their soldiers are still partly equipped with one and partly with the other. Even single companies of infantry have been found using both sizes of rifles and a consequent mixture of ammunition. On top of this confusion, they have three different types of cartridges in the 7.7-mm. size, which are only partly interchangeable among the larger rifle and various machine *(Continued on page 207)*

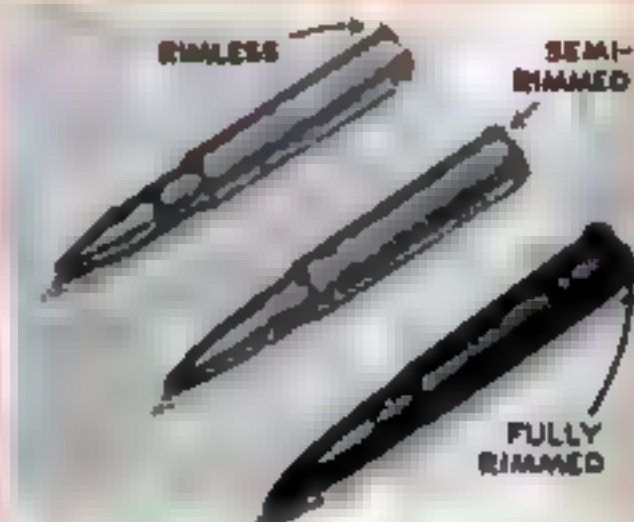


LIGHT MACHINE GUNS, too, are made by the Japs in two calibers, 6.5 and 7.7-mm. The gun at top, above, with the flash hider, is the 7.7. Both are viewed with respect by our ordnance men. Workmanship is not up to American standards, but design is simple and they spit a lot of lead before they jam



CARTRIDGE PUZZLE.

Private Moto has three 7.7-mm. cartridges. One can be used in an infantry rifle—another, in a light machine gun, the third, in a heavy machine gun. Americans wouldn't do that



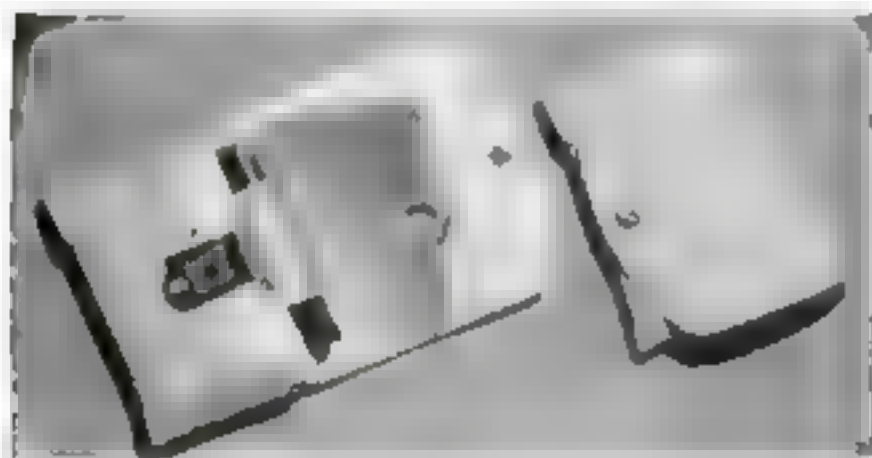
HEAVY MACHINE GUN of 7.7-mm. (about .30 caliber) size is a modified version of the Hotchkiss developed by France. Shoots 200 to 450 rounds a minute with muzzle velocity of 2,400 feet per second. It can use only semirimmed cartridges made specially for it. This cockeyed arrangement is explained by poor thinking at the start, plus inability to change later



What's New in Modern Living



COMPLETE SHAVING NEEDS have been included by Worthington Fifth Avenue, of New York, in a 2½" by 3½" pocket case.

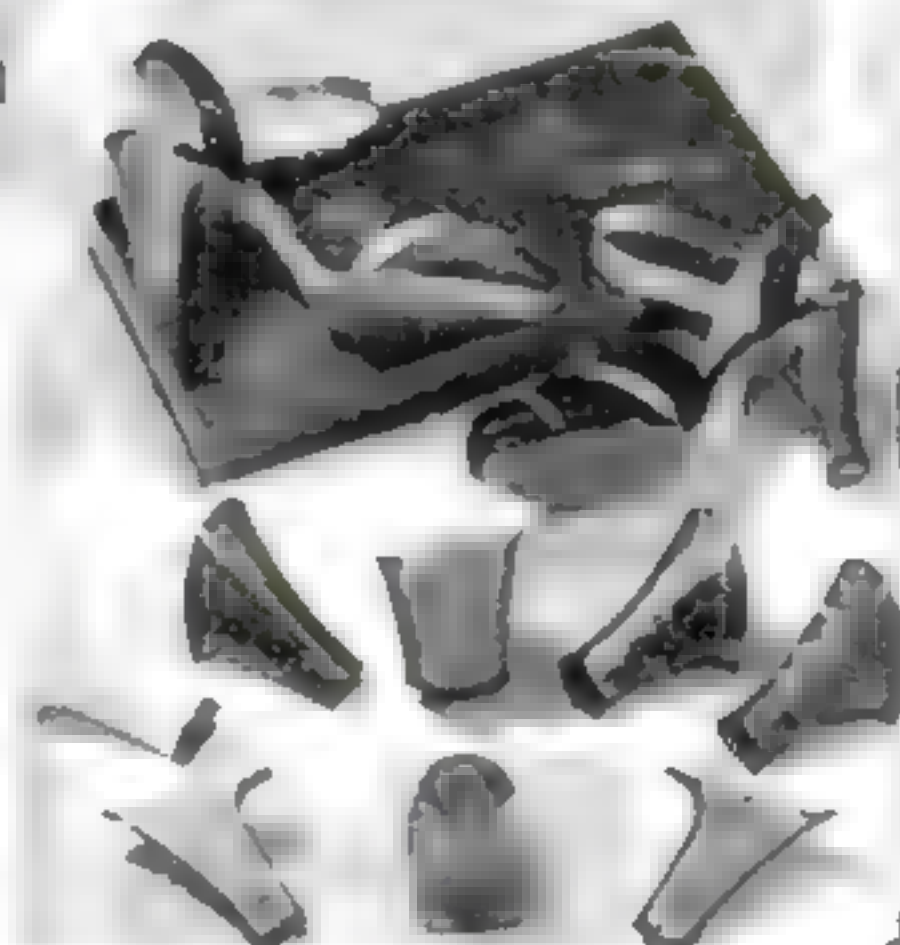


CIGARETTE ROLLING has again become a popular (sometimes not so popular) pastime with smokers. Here is an entirely new automatic roller that fits the vest pocket and makes a tight cigarette.



SOYBEAN SHOE PATCHES for resoling footwear at home are spread on worn spots on soles and pressed in with an iron. The material comes in the form of dough. It is manufactured by Elliot E. Simpson Co., of New York.

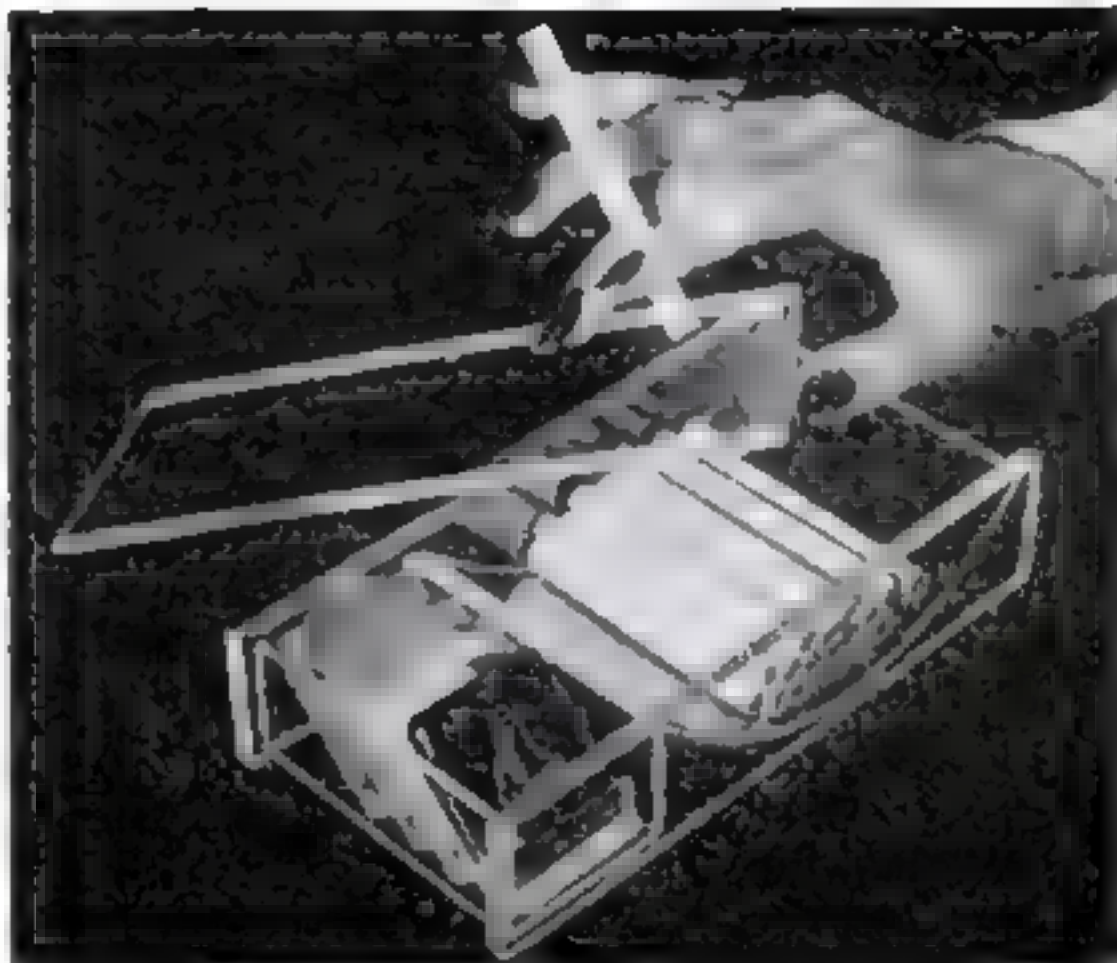
PLASTIC-COVERED HEELS for women's shoes are available in dull or glossy finish and in a variety of colors. These nonscuff heels, made by Pereles Bros., Inc., of Milwaukee, have wood cores that take leather lifts.



Open the cylinder and fill it with tobacco; then close it and turn the knob several times before inserting a paper. Revolving forks in the gadget equalize the tobacco to help in rolling.



DOLL MUFFS are one of the latest novelties. The one shown below has a doll's head and body, and the muff part forms the skirt. It was displayed at the recent New York exhibition given by the Toy Manufacturers of the U.S.A.



MATCHES AS WELL AS CIGARETTES have space in this newly designed cigarette box of transparent plastic of the type made famous in bomber noses. They are made by Vargish & Company, of New York.



OIL IS REMOVED from skin or metal by an absorbent made by the Waverly Petroleum Products Company, of Philadelphia, and contained in a pad, as shown at the left.

A DISPENSER is combined with a bottle stopper manufactured by Hollywood Home Accessories, Inc., of Los Angeles, for carbonated beverages.



2 Next, lift the lid slightly, insert the edge of a paper, and roll the paper part way into the cylinder. A special gummed-edge paper is used, and the gum is moistened just before it enters the chamber.

3 Complete turning the knob, open the cylinder, and you have a well-packed, professionally rolled cigarette. The device is the invention of and is marketed by John A. Kappeler, of Dayton, Ohio.





Things Boil Over at the Model Garage

NO MATTER how busy a day he has ahead, Gus Wilson tries to start it slowly. He takes his time eating a he-man breakfast, and when he gets to his Model Garage shop he begins operations by doing some easy job before he tackles a hard one.

"It's common sense," he says when we kid him. "If you want an automobile engine to work right and last a long time, you don't drive it hard before it gets warmed up. It's the same way with human machinery. If you start easy in the morning, it'll do more work for you before night—that's been my experience, anyhow."

But the morning that old Silas Barnstable picked to put up a squawk about the statement Joe Clark had mailed him, Gus didn't get a chance to start slowly. When he got down to the shop he found Doc Marvin waiting with a job he wanted done quickly because he had to get out in the country to attend a sick kid. It was a bothersome, dirty, hard-to-get-at job, and when Doc drove away Gus's normally good temper was wearing thin at the edges.

Then Silas came in, looking even more like a bantam rooster than usual. He's our town's most notorious skinflint—a dried-up little ex-farmer who sold off his rocky acres for suburban building lots during a boom 20 years or so ago.

Silas smacked the bill down on Gus's workbench. "I won't pay

it!" he snarled. "It's robbery! Jes' because a body's been foresighted enough to lay by a few dollars ain't any reason he should be cheated right and left. You've got to shade that bill down, Gus Wilson, or I'll never give your shop another job!"

If Gus had been in his usual good humor, he would have grinned tolerantly at the old crab, kidded him a little, and soon made him admit there wasn't anything wrong with the bill. But he wasn't in his usual good humor, and his temper slipped the leash.

"I'm sick and tired of hearing you yap about every bill Joe Clark sends you!" he snapped. "If you never come in here again it'll be soon enough to suit me!"

For a moment old Silas thought Gus was fooling. When he saw that he wasn't he started to say something, thought better of it, snatched the bill up off the workbench, and stalked out with his skinny little back as stiff as a ramrod.

Gus watched him go, and he began to feel sorry. He hesitated a moment, and then started for the door. But before he got to it, an engine took off outside, and Silas's sedan shot out of the drive and headed up the highway. Gus stared after him.

"Now," he asked himself, "what the dickens made me boil over? That's what comes of breaking my rule to start slow and easy in the morning. Well, it's nothing to worry about—he'll be back in a week or so, ornery as ever."

But weeks added up to a month and more before Gus saw Silas again. Then it wasn't in the Model Garage, but downtown as he was going into the Park House for the weekly Kiwanis luncheon. He noticed steam clouding out of the radiator of Silas's sedan, which was parked at the curb, and then saw Silas hurrying across the sidewalk with a pail of water and an anxious look.

Gus walked over. "Hello, Silas," he said cheerfully. "Want a hand?"

Silas looked at him as if he'd never seen him before. Then he poured the water into the radiator, replaced the cap, tossed the pail into the back of his sedan, climbed stiffly into the driver's seat, slammed the door after him, and drove away.

Gus's face turned red. Policeman Jim Devine, who had been watching, grinned widely. "The old rooster's sure got his ax out for you, Gus," he said. "He's telling everyone you overcharged him and then insulted him when he kicked, and that he's off you for life. Of

By Martin Bunn

course, nobody pays any attention to him, but—"

Gus grunted and went into the Park House. He didn't enjoy his lunch that day.

ONE afternoon a couple of weeks later, Joe Clark came into the shop looking peeved. "That fellow Brindley's on the phone," he told Gus. "Says he can't find out what's the matter with a job he has in his place, but he knows you can, and he wants to bring it over. The nerve of him! What'll I say—that you're too busy?"

Brindley is a young chap with a medical discharge from the Marines. He has opened a neighborhood garage on the other side of town from Gus and Joe's place.

"Tell him to bring it along, of course," Gus replied. "I'm busy—but not so busy I can't take time to give a hand to a kid who's trying to get started."

"Now, look here, Gus," Joe said earnestly. "There's a limit to good nature! I haven't kicked—much—about you telling a lot of fellows how to do jobs they ought to bring to us. But when it comes to helping an out-and-out competitor—"

Gus grinned. "We're turning down work every day because we can't handle it. And as for helping young Brindley—well, it seems to me that he was helping us when he got himself shot up on Guadalcanal."

Joe went back to the office growling, but half an hour later Brindley drove in a sedan that Gus recognized at once as Silas Barnstable's. Its radiator was steaming.

Brindley was embarrassed. "I'll bet you think I've got a nerve, Mr. Wilson," he said, "and I guess I have. But you're the top man on car troubles around here, and I thought maybe you'd help me out. I told the man

Silas hurried across with a pail of water and an anxious look



who owns this car that I could fix it, and now I can't even find out what's the matter with it!"

"We all get 'em that way once in a while," Gus said. "The radiator's boiling—no doubt about that, anyway. Suppose you tell me what you've done."

"Sure," Brindley said. There was relief in his voice, but an undertone of embarrassment, too. "There was quite a lot of work done before the owner brought the car to me. When the boiling started, he took the bus to a big shop down in the city. They checked the spark and valve timing. When they couldn't find anything wrong there, they thought that maybe the overheating was being caused by too lean a mixture, so they had their carburetor expert check the intermediate and high-speed jets. They were all right, too, so they sent the radiator to a radiator specialist to have it boiled, and then they pressure-cleaned the entire cooling system with live steam to get rid of all the inside scale. They charged a good high price for the job, and when the radiator began to boil again a couple of days later, the owner really popped off."

"Someone told him about my place, and he brought the car in. When I took the engine head off and found several of the valves burned, I figured they were causing the overheating and that regrinding would cure it. But after the valve job, the radiator was boiling as bad as ever."

"O.K.," Gus said. "I'll have a look." He got in and started the engine. "What clearance did you give the valves?"

Brindley snapped his fingers. "I am dumb," he said. "I clean forgot to tell you that two of the valves were burned so badly I had to replace them."

Gus switched off the engine. "You did?" he said. "How about the spark plugs?"

"Pretty well burned," Brindley said.

Gus got out of the car and called: "Stan! Get me the vacuum gauge!"

When the grease monkey brought the gauge, Gus attached it to the intake manifold at the windshield-wiper connection, started the engine, and let it idle. He saw the gauge read 16". "Not very high," he commented. "Take the muffler off, Stan."

Gus got back into Silas's car after Stan had finished. This time the engine took off with a roar. He throttled it down to idling speed, got out, and looked at the vacuum gauge, which now showed 20".

"I thought so," Gus said. "Switch her off, will you, Brindley? Your troubles are over—or they will be when you install a new muffler and collect your bill."

Brindley showed astonishment. "What you say is good enough for me, of course—but I don't get it. What's the muffler got to

do with the radiator boiling—and how can you tell, without even lifting the hood, what caused the trouble?"

Gus grinned. "Oh, it's just a matter of adding one thing to another and getting a sensible answer. That's where experience comes in—and experience is something a mechanic picks up as he goes along."

"To start with, every car cooling system is designed to handle just about so much heat, and not much more. When the engine generates more heat than the system can dissipate, the radiator boils."

"I knew from what you told me about the work that had been done before the car was brought to you that the radiator couldn't be clogged and that the timing hadn't gone haywire. When you told me that the valves were burned so badly you had to replace two of them and that the spark plugs were burned, I knew that the extreme heat from burning gases around the valve and valve ports wasn't being carried away quickly enough. The most likely cause of that is back pressure in the exhaust system caused by a restriction in the muffler. When the gauge registered 16" of vacuum with the muffler on and 20" with it off, it showed that the muffler caused the overheating. Let's look."

Gus got the muffler and opened it. It was almost full of scale and corrosion. "There," he said. "Put on a new muffler, and you won't have any more trouble."

"Say, that's remarkable," Brindley exclaimed. "Well, now—what do I owe?"

Gus laughed. "Forget it. Some day you'll give me a lift."

The ex-Marine hesitated; then he said: "There's something I ought to tell you. The man who brought this car to me was a customer of your's."

Gus laughed again. "I never forget a car," he said. "Do me a favor—don't tell the old grouch I had anything to do with it."

TWO weeks later Gus looked up from his workbench and saw Silas Barnstable standing beside him. "Well," he asked unceremoniously, "what do you want?"

"Want to pay my bill," Silas told him, fishing it and a check out of his pocket.

"You're in the wrong department," Gus retorted. "Go see Joe Clark."

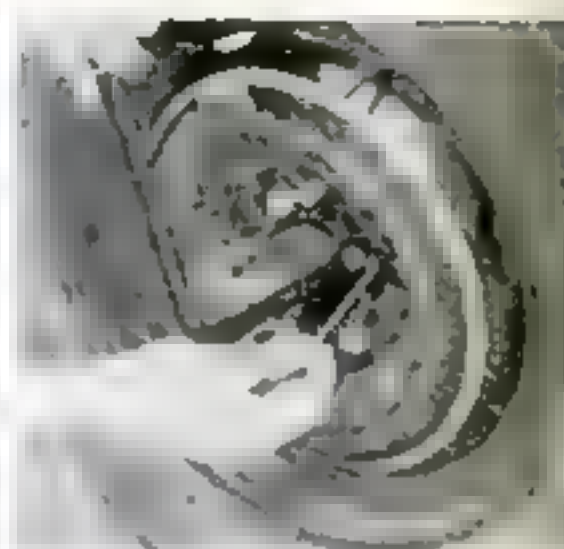
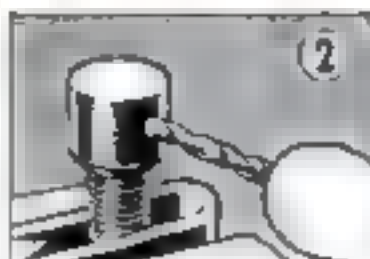
"No reason to snap a feller's head off!" Silas complained. "Look here, Gus—I got it out of that young Brindley that you fixed my car up when nobody else could. Let's forget and forgive."

"Oh, all right—all right," Gus said.

Silas appeared relieved. Then he got a worried look. "That don't mean that I'm goin' to put up with any overcharges, Jes' because a man's laid by—"

"Scram!" Gus grunted. "I'm busy!"

— IDEAS FOR THE CAR OWNER —



TIRE THEFT is made extremely difficult if you make use of the simple procedure outlined in the photos and drawings above. In principle, the method consists of rounding one tire-retaining nut or bolt so that it cannot be turned by a lug wrench without a special key. The idea is adaptable either to the nuts or the bolts variously used with pressed-steel wheels.

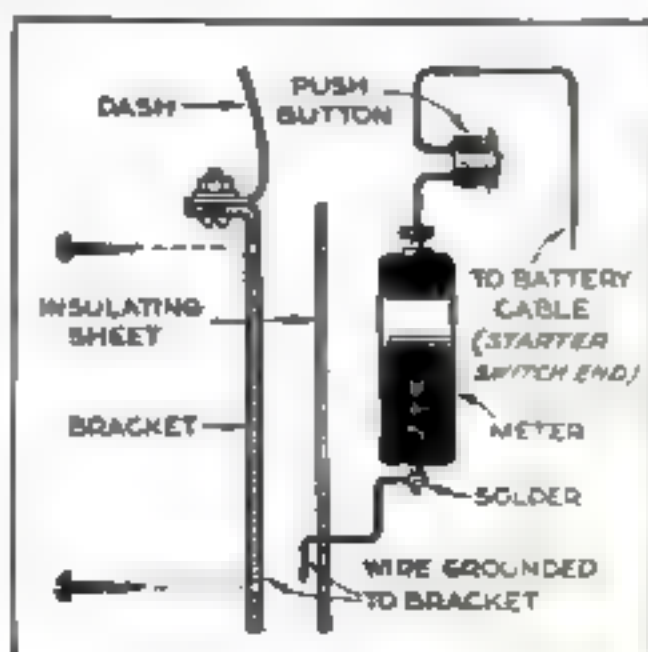
Remove one nut or bolt from each wheel, as in the photo at the left; since only one is taken from each wheel, it isn't necessary to jack up the car. Secure each nut or bolt in

a vise (protecting the threads if you have bolts), and file off the corners as in Fig. 1. The job can also be done on a grinding wheel. Test the nut or bolt to make sure that the wrench won't hold, then drill a $\frac{3}{16}$ " hole through it, as in Fig. 2. A similar hole, Fig. 3, should be drilled through the lug wrench, located about $\frac{1}{4}$ " back from the edge. For the key, use a 20-d nail with a right-angle bend about $\frac{3}{4}$ " from the end (Fig. 4). The photo at the right shows how the key is held in changing a tire safeguarded this way. — C. P. FITZPATRICK

TESTING THE BATTERY can be done in an instant with the handy dashboard meter shown in Fig. 1. It consists of a storage-battery tester, a push button, and a block of wood that serves as a mount. When in doubt about your battery, it's necessary only to press the button and note where the meter hand stops to tell whether the battery is dangerously low or sufficiently charged.

The tester should be the inexpensive voltmeter type, calibrated in zones to indicate degree of charge. With an expansive bit or chisel and gouge, hollow out the back of the 1" mounting block to receive the tester, as in Fig. 2. Determine which of its terminals should be connected to the ungrounded side of the battery, and install a push button in series with this side. Run a well-insulated wire from the button to the end of the battery cable that is connected to the starter switch. The other terminal on the tester should be grounded through the mounting bracket to the dash. Figure 3 shows this metal bracket, which also serves to hold the tester in its recess. A piece of cardboard will insulate the meter case from the bracket.

Take readings after the car has been idle for a time; you may not get accurate results after the generator has been charging the battery or after a heavy starting drain. To verify calibration of the meter, note the reading when the battery has been fully charged, and use that as a subsequent reference point. — W. E. B.





By TOM McCaHILL

ANNOYING though it may be when your engine develops a click, rattle, thump, squeak, or pounding that you haven't heard before, such noises serve two valuable purposes. They act as danger signals, and they also serve as clues by which you can determine where the trouble lies. Once you have tracked down the sound to its source, it is usually easy to decide what, if anything, you ought to do about it. Some noises—once you know what causes them—can safely be ignored.

Any knock is first of all a warning—a

ENGINE NOISES

Does Your Engine Purr . . .

warning that some part of your engine isn't functioning as it should. It usually comes in plenty of time for you to make the necessary repair before serious damage is done. And for the wartime driver, faced among other things with a shortage of major replacement parts, this is a blessing.

All drivers are familiar, of course, with the fuel knock—seemingly always present nowadays when all our high-quality gasoline is going to the armed forces. Provided ignition timing is correct and the engine isn't loaded with carbon, this knock simply means that the engine wasn't designed for the poor gas it is forced to burn.

But those raps, slaps, thumps, metallic knocks, clicks, throbs, roars, whines, hums, and squeals—they can mean something entirely different, and they frequently do. You will find it well worth your while to learn what each means, if only to know which can be safely ignored and which can't.

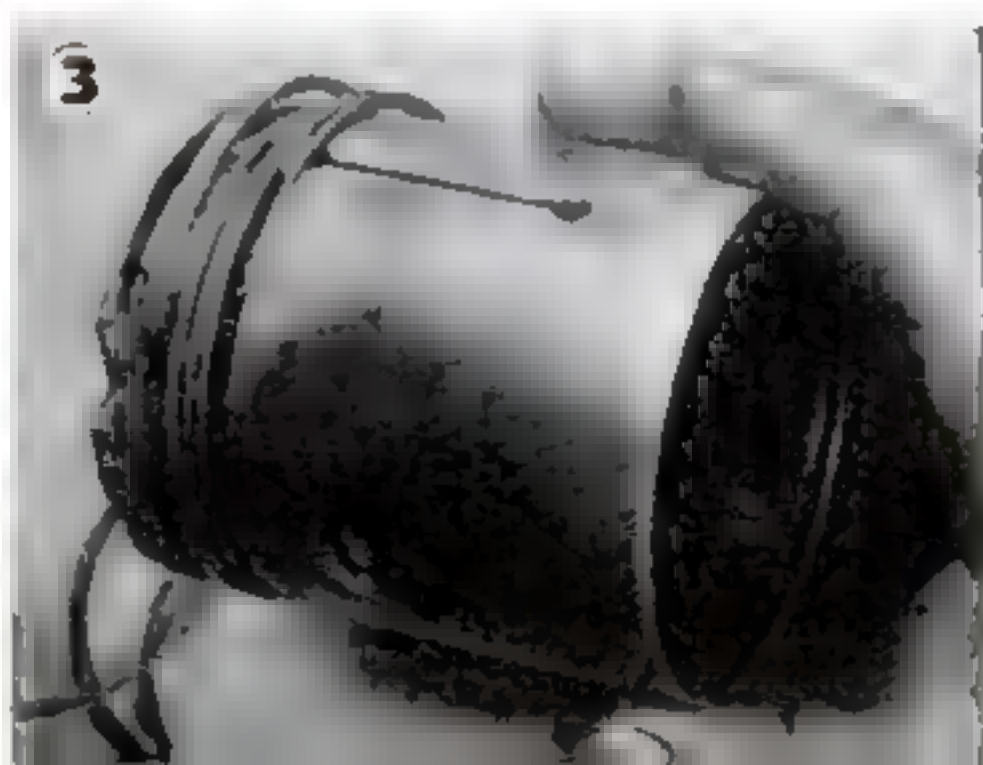
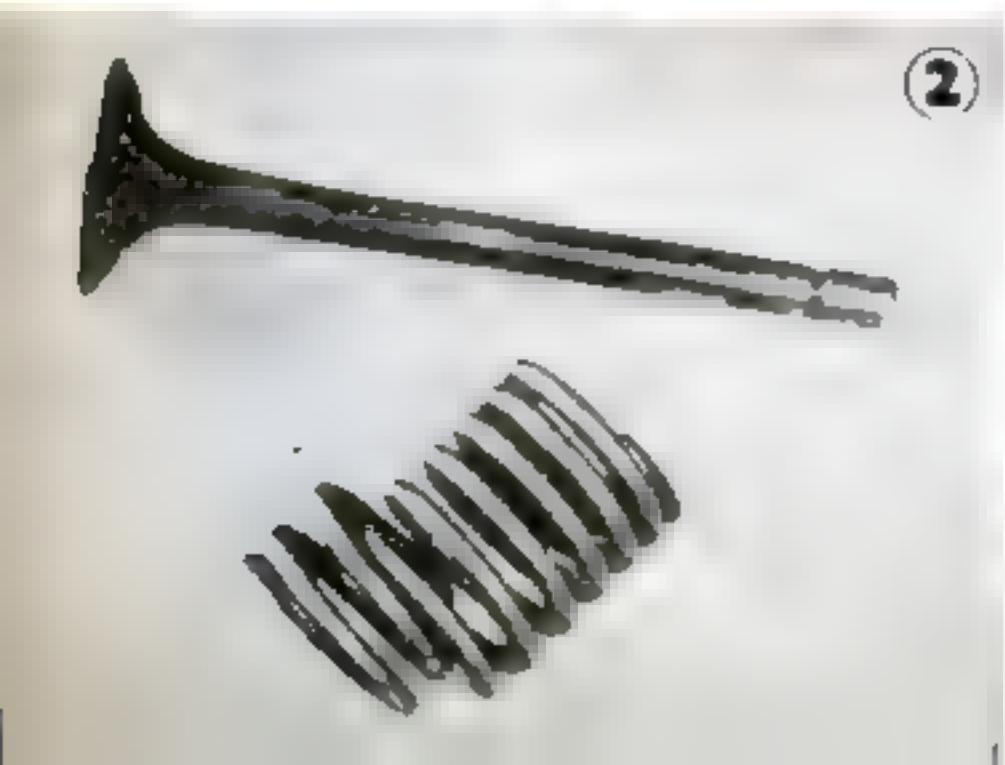
An illustrated table of eight of the most



1 Shorting out each cylinder in turn will often locate the one in which the cause of a knock exists. This eliminates much unnecessary work in hunting for a faulty part. Short the spark plug with a screwdriver that has an insulated handle

2 Warped valves or broken springs like those shown in the photo cause rapid clicking. The noise can be lessened by the shorting test. New parts should be installed for the defective ones

3 Running an engine having broken piston rings can cause trouble. The ruined piston shown below was chewed up by faulty rings. Sharp clicks at all engine speeds indicate a broken ring. The noise is not decreased by shorting the spark plug



AND WHAT THEY MEAN

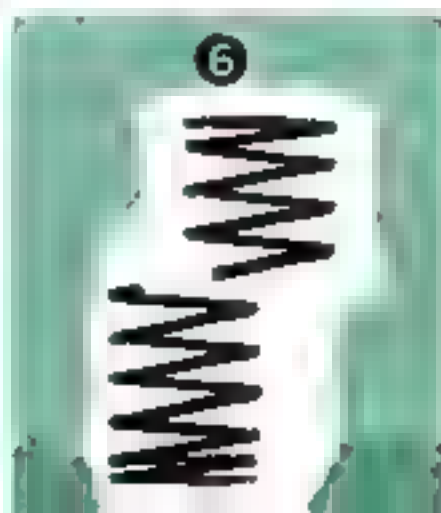
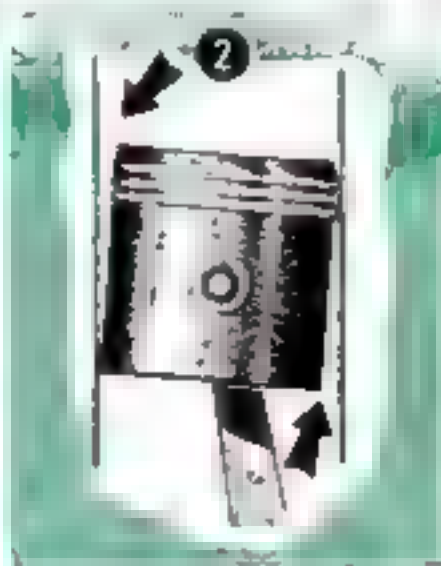
or Does It Knock, Thump, Pound, and Chirp?

important of these noises is given in the chart below along with their causes and cures. You must remember, though, that noises in an engine are at best difficult to describe, and many are so nearly alike that you may find it hard to distinguish between them. With practice you should be able to tell most of them apart and learn to locate the underlying trouble by considering three

factors: the kind of noise, when it occurs, and what effect shorting out spark plugs has. This will prove a great help in determining whether to look for it on the spot or whether you can postpone the search until a convenient time.

A simple trick is used by expert mechanics to locate a knock. They hold a screwdriver or other rod of iron or steel to various parts

COMMON ENGINE NOISES				
SOUND	WHEN HEARD	CAUSE	DIAGNOSTIC CHECK	TREATMENT
SHARP RAP	IDLING SPEED	① LOOSE WRIST PIN	CAN BE SHORTED OUT	REPLACE PIN
FLAT SLAP	ACCELERATING UNDER LOAD	PISTON SLAP ②	CAN BE SHORTED OUT, LESSENS WITH HOT ENGINE	REBORE BLOCK AND REPLACE PISTON
INTERMITTENT, HEAVY THUMP	RUNNING WITHOUT LOAD	CRANKSHAFT END PLAY ③	CANNOT BE SHORTED OUT, DISAPPEARS UNDER LOAD	TAKE UP
METALLIC KNOCK	IDLING AND SLOWING DOWN	WORN OR LOOSE BIG-END BEARINGS ④	CAN BE SHORTED OUT, DISAPPEARS UNDER LOAD	REPLACE BEARING
RAPID CLICKING	CONSTANT	INCORRECT VALVE ADJUSTMENT ⑤	CAN BE SHORTED OUT BY CYLINDERS, FEELER GAGE SHOWS WRONG GAP	READJUST
LOUD, RAPID CLICKING	CONSTANT	BROKEN VALVE SPRING ⑥	CAN BE DULLED BUT NOT STOPPED BY SHORTING	REPLACE
THROB, ROAR, KNOCK, OR CLICK	CONSTANT, CONSPICUOUS ON ACCELERATION AND AT HIGH SPEED	LOOSE MUFFLER, BAFLE, OR PIPE ⑦	CANNOT BE SHORTED; INSPECT FOR TIGHTNESS	TIGHTEN OR REPLACE
WHINE, HUM, OR SQUEAL	CONSTANT, CONSPICUOUS AT IDLING SPEED	WORN WATER PUMP OR FAN-PULLEY SHAFT OR BEARING ⑧	CANNOT BE SHORTED; DISAPPEARS WITH GREASING	GREASE, REPLACE IF NEEDED



of the engine and listen at the other end to locate the point at which the noise sounds loudest. This may not be easy at first, but with a little practice the trick should prove valuable. Try holding your thumb on the rod at one end. Place your ear close to the thumb and touch the engine here and there with the other end of the rod.

If the noise originates in one cylinder, it can often be located by a process of shorting it out. In this test use a screwdriver with a wood or insulated handle and simply short out one spark plug after another until the noise disappears during the shorting. The cylinder in which the trouble is occurring can thus be determined, and the loose wrist pin, slapping piston, faulty connecting-rod bearing, or defective valve can then be ferreted out without taking down more of the engine than is necessary.

A loose or worn big-end bearing on a connecting rod can be located in this way. It also often makes itself known to the experienced mechanic by its metallic knock when the engine is idling or slowing down—a noise that disappears when the engine is under a light load. One test is to accelerate the engine and then to close the throttle suddenly, at which time the knock should be very pronounced. Examine the bearing, and if it is worn or loose, the most practical treatment is to replace it with a new one.

The identifying noise of a loose wrist pin is a sharp rap, also occurring at idling speed. Such a pin is also best replaced by a new one. If the old pin is broken, the noise will be very loud and very metallic. Such a pin is dangerous as it may break the piston and cause serious damage to the engine. Even if the noise can't be shorted out entirely, shorting will soften the sound.

A piston that has become loose in the cylinder slaps against the walls with a flat, slapping sound heard when accelerating and when under load. It is less apparent when the engine becomes hot. The noise disappears when the correct cylinder is shorted out. The remedy is to remove the faulty piston, rebore the cylinder, and install an oversize piston. Broken rings cause a sharp click at all speeds and can't be shorted out. They should be replaced before they do any damage.

Loose main bearings are indicated by a deep, heavy, dull thump, increased on acceleration and under a heavy load. However, loose bearing shells in the crankcase cause a knock so similar to a main-bearing knock that it is almost impossible to distinguish between them without tearing down the engine for inspection. If a main bearing is at fault, it is best to replace all the main bearings while the engine is torn down; but only the bearing shell that is loose needs

to be replaced. A loose shell can rarely be made to fit correctly again. Too much end play in the crankshaft causes an intermittent, heavy thump. It disappears under even a slight load. The end play should be taken up by the means provided in the design of your particular engine.

Replace loose camshaft bearings, but check first for broken or sheared dowel pins and replace them as well as the faulty bearings. Inspect the gear if end play is indicated, for it may not be tight enough on the shaft and pressing it on tighter may eliminate the difficulty. If a worn thrust plate causes end play, it should be replaced by a new one, as should a gear that has a chipped or broken tooth.

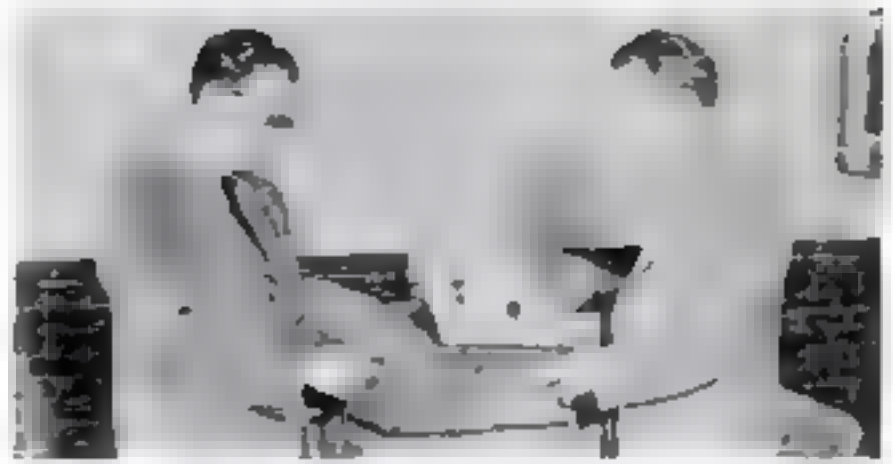
Valve noises range from light taps and slaps to squeaks and knocks, and as a rule they do not indicate trouble that might lead to a major breakdown. The most common are those caused by improperly adjusted push rods where excessive clearance results in tapping. It is simple to readjust them to the manufacturer's specifications unless the adjustment units have become worn, in which case new adjustment units should be installed. You can short out or reduce noises caused by incorrect tappet adjustment.

It may be necessary to put in a new push-rod assembly if wear in the push-rod guides cause side slap. If the assembly is loose on the block, indicated by a rattle, a general tightening of all nuts is sufficient. New valves and guides are required when valve stems are loose in the guides. If valves stick, the engine should be cranked over slowly with the valve cover off so you can see whether all the valves come to a normal closed position. Any that do not will probably be warped or have a broken spring. Defective units should be replaced. Broken valve springs cannot be shorted out completely, but the sound can be dulled.

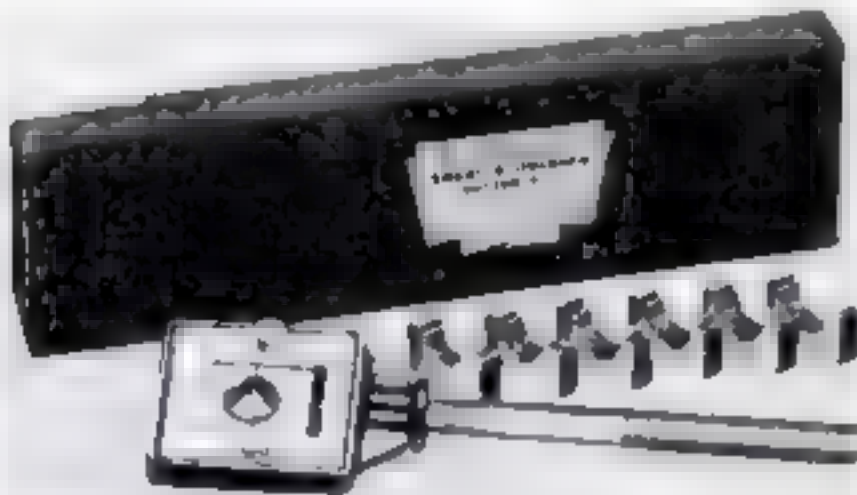
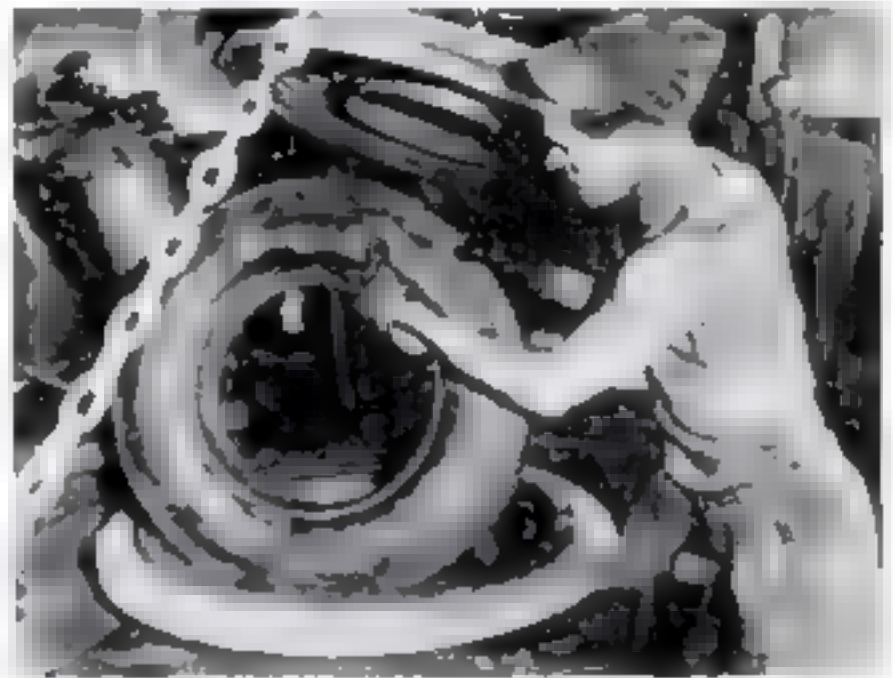
In addition to these main engine noises, there are miscellaneous knocks and thumps that it is well to know. Various loose engine supports may allow the engine to thump on its bed on rough roads or when the clutch is being engaged or disengaged. A loose muffler or loose baffle plates in the muffler can set up a disturbing racket, as can a loose tail pipe. Ungreased or worn water-pump bearings or ungreased fan pulleys will often cause an eerie whine. A loose flywheel knocks most noticeably when the engine is accelerated and also while the clutch is being engaged or disengaged. Wear in a distributor shaft or bushing often causes a grinding noise when the engine is idling. Timing gears that are meshed too tightly will hum like a worn rear end but not so loudly. Most of these parts can await repair at your convenience.

AUTO *Ideas*

DANDELION TIRES are now being manufactured at the B. F. Goodrich plant in Akron, Ohio. The rubber from which they are made, shown in bales at the right top, is produced from kok-saghyz, a Russian variety of dandelion. Seeds of the plant were flown here from the U.S.S.R. in 1942, and from them was grown the kok-saghyz used by Goodrich. Company experts say that the tires, all of which are going to Government use, are of top quality.

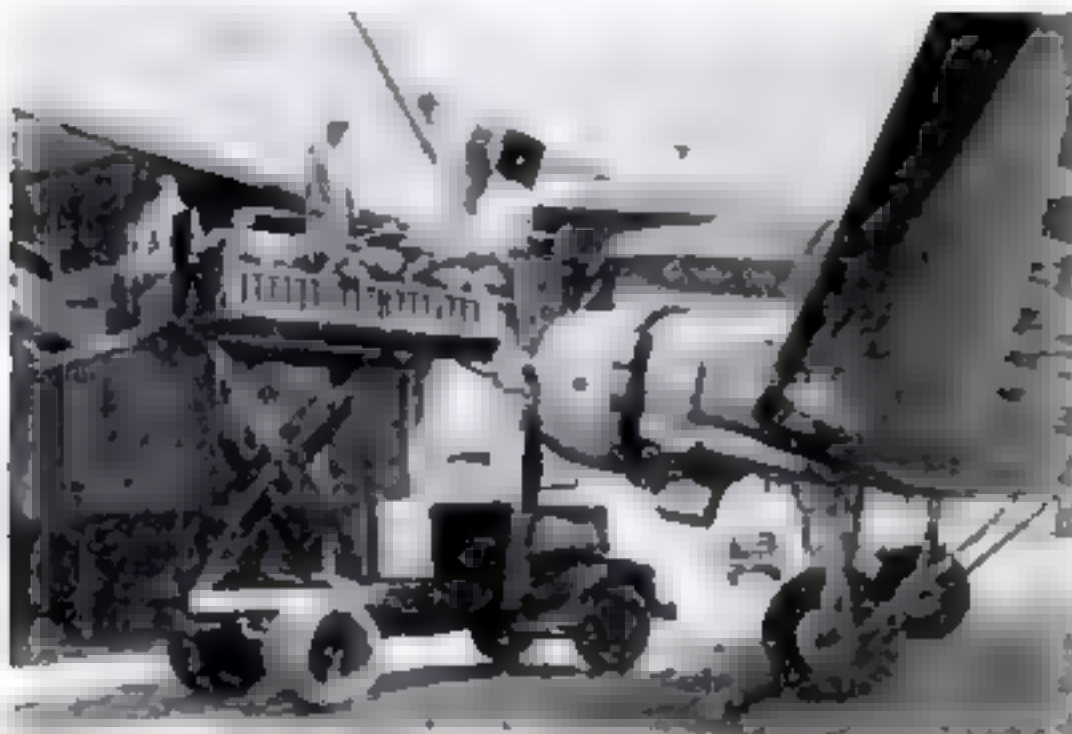


Emerging from its mold, below, is a dandelion tire



RETHREADING AXLES is made easier with the die kit shown above. Worn or damaged axle threads are corrected by placing the proper size of split die in the holding tool, locating the tool over the worn threads, turning the handle to tighten the split dies, and then backing the tool off. The makers, the New Britain Machine Company, say that the design of the tool makes it possible to tighten the die halves evenly at all times. The kits are available in a size for passenger cars and a size for trucks.

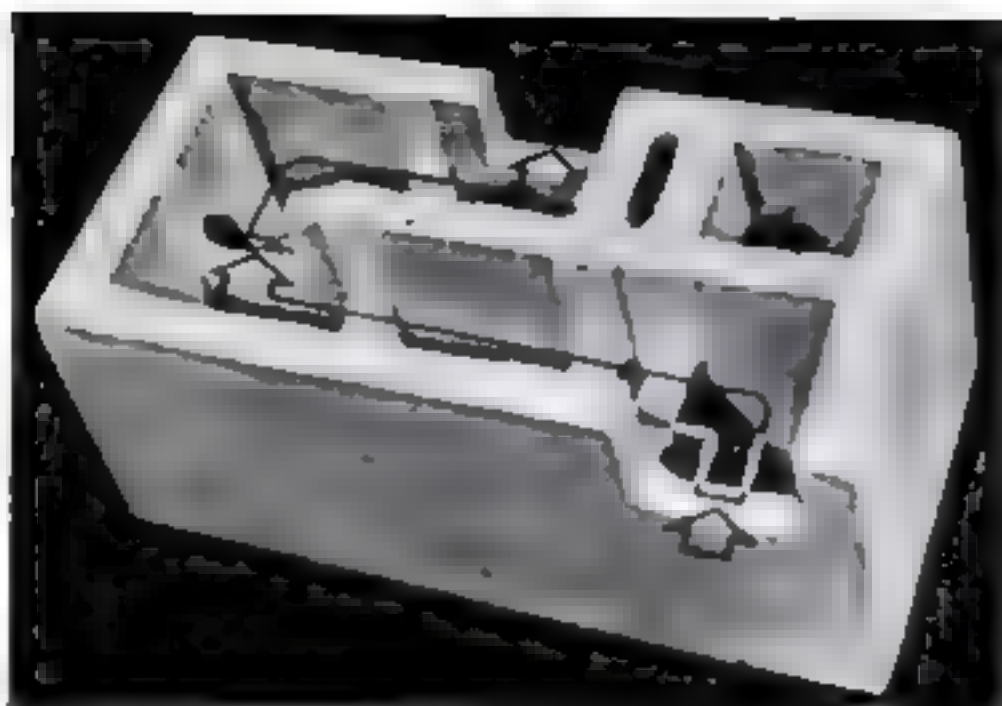
SUN TANS EN ROUTE are a possibility for the owner of an enclosed car who has the compact ultraviolet lamp pictured below. Designed for operation on the 6-volt storage battery of a car, the lamp is 4 1/4" by 4 1/4" by 9 5/8" and weighs 3 lb. It can either be attached to the dash or hung wherever convenient within the auto. In addition to its tanning and therapeutic uses, the lamp also tends to sterilize the air inside the car when it is in use.



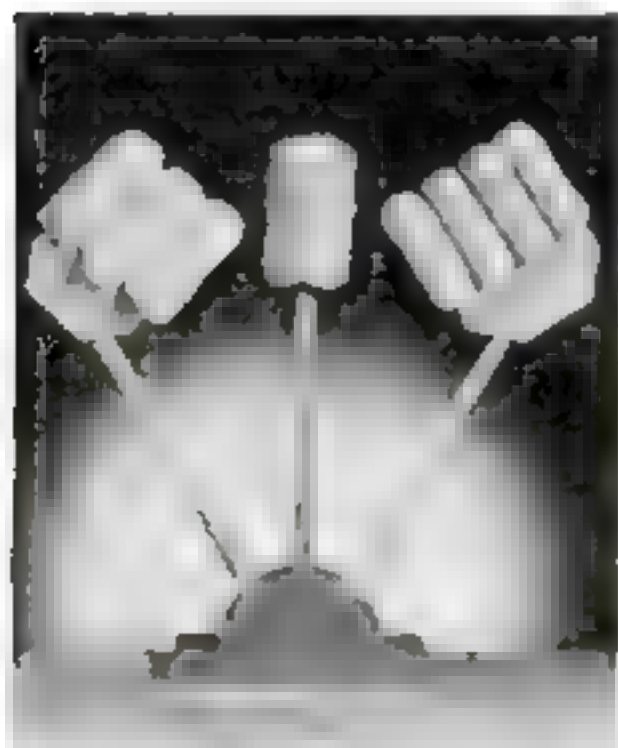
PLANE LOADING from trucks gets a boost in speed and efficiency with the high-lift truck body shown in the photograph at the left. Twin hydraulic cylinders operate a scissors-type mechanism to lift the loaded body up to a maximum height of 10', or to any intermediate heights, depending on the floor level of the loading door on the plane. Designed for use on Army trucks of 2 1/2-ton size, the unit has a maximum payload capacity of 8,000 lb. It was developed by the Heil Company, of Milwaukee, Wis.

OF INTEREST TO HOME OWNERS

DRAINAGE SCUPPERS that work satisfactorily in a wall can be improvised from ordinary building tiles of the kind shown in the photo at the right. The openings can be cut efficiently with a silicon-carbide abrasive saw. Leaving a baffle down the center between the outer and inner openings, as indicated, makes the tile scupper lightproof. This simple solution to the problem of finding a substitute for prewar metal scuppers was



worked out by a construction foreman for the Eastman Kodak Company in Rochester, N. Y., where he employed his adaptation for both drainage and ventilation and in both inside and outside walls.



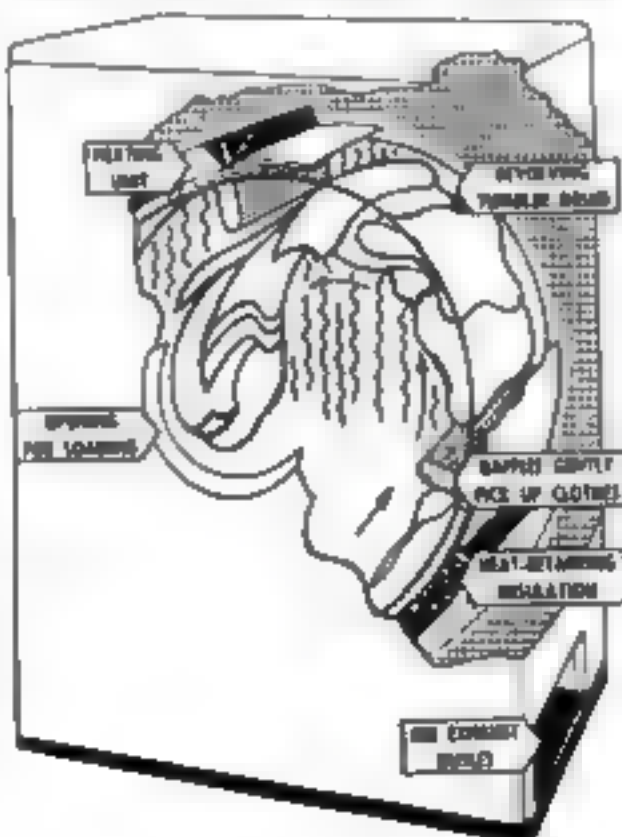
VENETIAN-BLIND DUSTERS with three and four lamb's-wool fingers are manufactured by The Lauer Company, of Chicago. The wool is mounted on steel wires and cleans both sides of a blind at once. Also made by the same company is a one-prong bed-spring duster.

CONCENTRATED FLOOR CLEANSER to be mixed with water before application is now being made for use either before waxing or on a waxed floor that need not be rewaxed except on worn spots. The substance, a Du Pont product, is put on with a mop or cloth and allowed to dry.



POSTWAR WASH DAY gives increasing promise of less work for the housewife. One of the latest announcements in improved washing machinery is the automatic clothes drier of the Hamilton Manufacturing Company, of Two Rivers, Wis. It will be made in both electric and gas models. Clothes are dried in a slowly revolving chamber through which warm air, controlled by a thermostat, is blown as indicated in the drawing. Ready-to-iron damp drying takes from 15 to 25 minutes on the average.

Up to nine pounds of clothes can be dried in this postwar-planned drier that is completely automatic



Mounted on figure-rolled glass and set in a glass case, this vessel makes an attractive display model.

TUGBOATS GO TO WAR TOO! HERE'S ONE IN MINIATURE.

By
E. J. Mooney



WATERLINE MODEL OF A NAVY TUG

OUR Navy uses this 65' tugboat extensively in its home waters. With many of the details simplified, and reduced to a scale of $\frac{1}{8}$ " to 1', it makes an interesting, easily built model. The profile, plan, and sectional drawings that appear on the next two pages are full-size reproductions; you can trace the necessary templates and patterns directly from them.

Make the hull from a $\frac{3}{8}$ " by $2\frac{5}{16}$ " by 8" block of wood, cutting it to the shape shown in the profile and the half plan. The top of the hull is identified in the plan view and in Section B-B, as well as in the profile. As indicated in Section A-A, the forward half of the hull is slightly curved between the waterline and the deck.

Use heavy cardboard or $1/16$ " wood for the deck. It extends beyond the hull all around to form a rub strip. Cement it in place and cut out a notch forward to take the cardboard stem. Make the rail, rail cap, and brackets from cardboard or thin wood. The bottom outboard edge of the rail is set in from the deck edge to line up with the edge of the hull. It slopes inward throughout its length except at the stem, where it is plumb. Cut three openings in each side, as indicated, to simulate freeing ports.

Make the superstructure from Bristol board. The sides and front are in one piece, as shown. Score and bend on the dotted lines; then cement the pilot-house top, trunk top, and after ends of the house and trunk in place. The molding around the top of the

pilot house is a piece of .040" wire. Cement pieces of black-painted celluloid to the inside so they cover all the cut-out openings; then glue the completed superstructure to the deck.

Oversize details are given for most of the fittings. Make the samson post from $\frac{1}{8}$ " dowel, paper-clip wire, and a carved wood button. Both double bitts consist of $3/32$ " escutcheon pins or button-head rivets, wood, and Bristol board. The anchor davit is a length of wire, bent, filed to a taper, and flattened as indicated. The hatches on deck are glued-down pieces of Bristol board. Use wire solder for the life raft—when painted, it will very nearly approach $\frac{1}{8}$ " in diameter. The water tank rests on Bristol-board chocks. Side-light boxes are mounted on short pieces cut from round toothpicks.

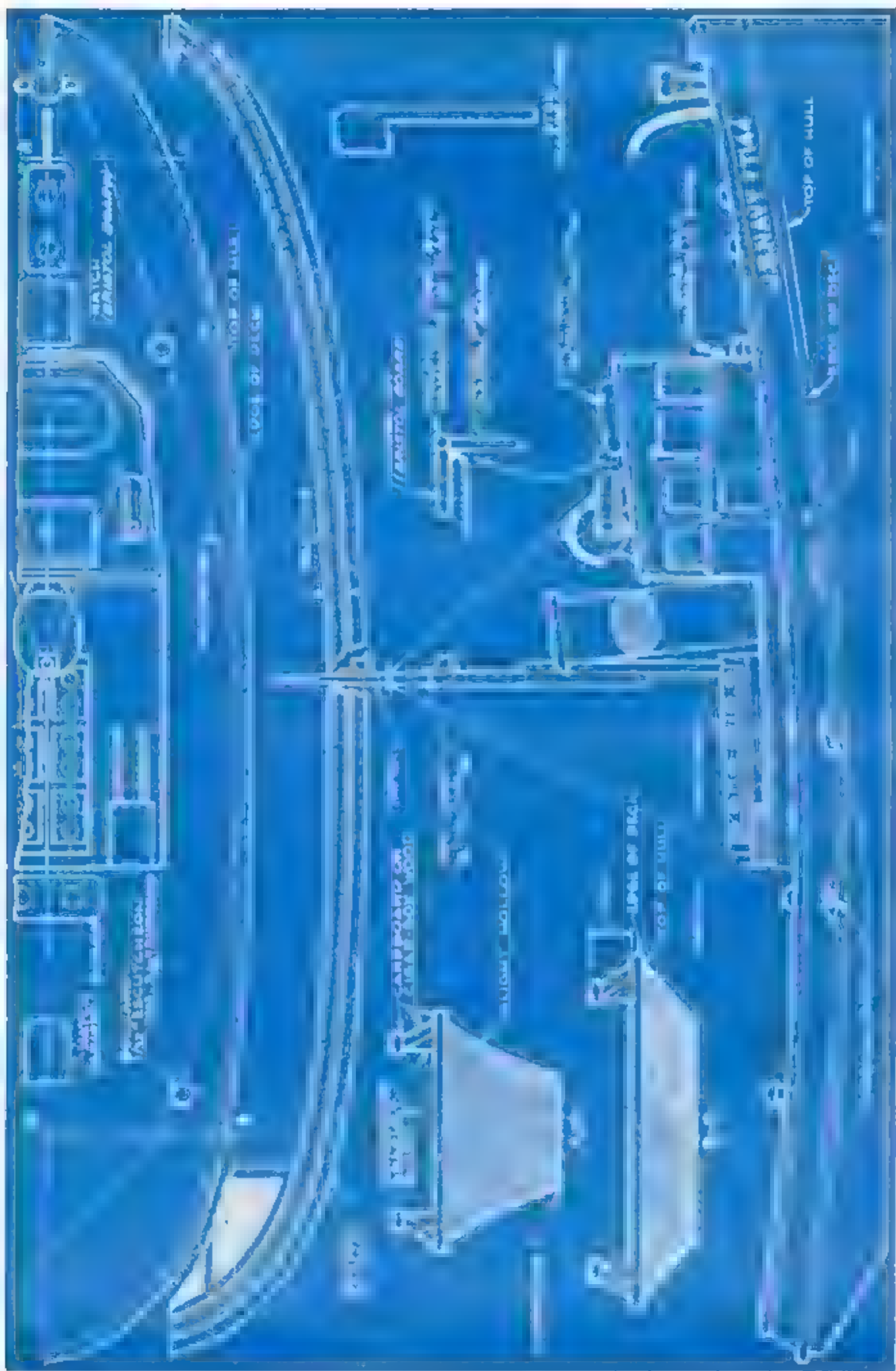
Finish the superstructure and deck with flat gray paint. Use black for the hull and trim. The starboard or right-hand light box is green; the other one is red.

For drawings, see next



Workhorses of the seas, unspectacular little tugs like this one are daily playing an important part in tending the Navy's more glamorous fighting craft.





DETAILS



Novel Corner Cupboard Holds Belts

By WALTER E. BURTON

PATTERNED after the well-known corner cupboard of Colonial days, this project has three shelves. The bottom one is slotted for holding belts; the two others will accommodate a few small trinkets.

Use $\frac{1}{4}$ " plywood for all the parts except the two sidepieces (Fig. 2) which are made of $\frac{1}{2}$ " stock. Jigsaw the front (Fig. 1) to the dimensions indicated. Bevel the vertical outer edges to a 45-deg. angle to match the surfaces of the walls against which the cupboard will be mounted. Cut the shelf as in Fig. 3 to fit against the bottom of the front, recessing the two short edges to receive the sidepieces. Fasten it to the front with brads and glue. Saw a piece of plywood $3\frac{1}{4}$ " by $3\frac{1}{4}$ " diagonally into two pieces to form the triangular parts that are shown in Fig. 5. Mount one on the front section, as shown in one of the photos at right, to form a top. Fasten the other to one of the sidepieces to form a shelf. Secure this sidepiece to the portion already assembled, add the other sidepiece, and fasten the belt shelf (Fig. 4) between the bottom ends of these pieces.

You can determine the size, number, and position of the belt slots so they will accommodate the types of belts you own. The buckles that are shown have rings that slide into the slots. Since each ring is off center with respect to the buckle face, it was necessary to arrange the slots in an unsymmetrical manner.

After assembling the cupboard, use a rasp and sandpaper to work down any edges that are not smooth or that do not match adjoining pieces. Finish off with fine sandpaper. Bore two holes near the centers of the two sidepieces to receive mounting screws. For a natural finish, apply two coats of clear linoleum lacquer. If color is desired, use an undercoat followed by two coats of enamel.

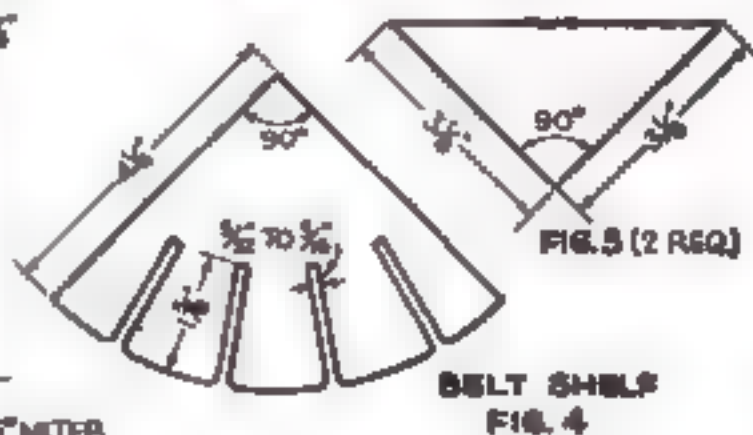
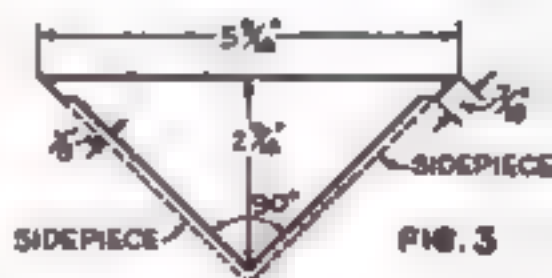
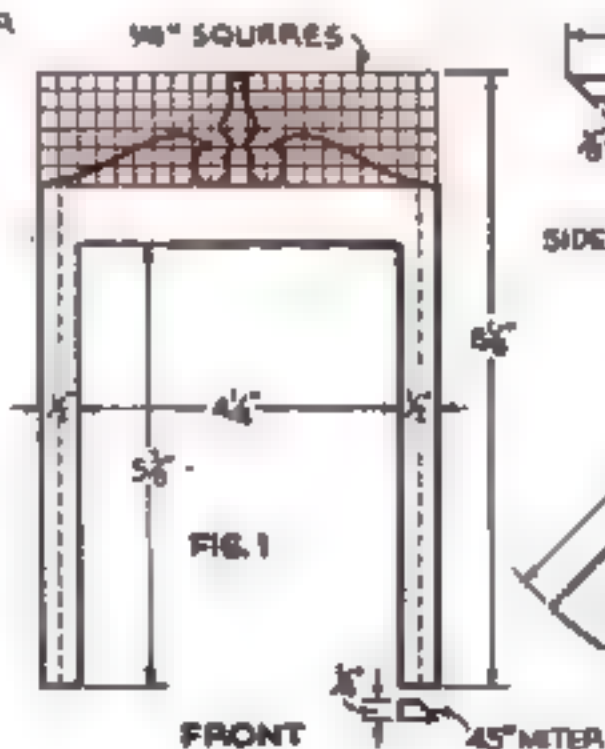
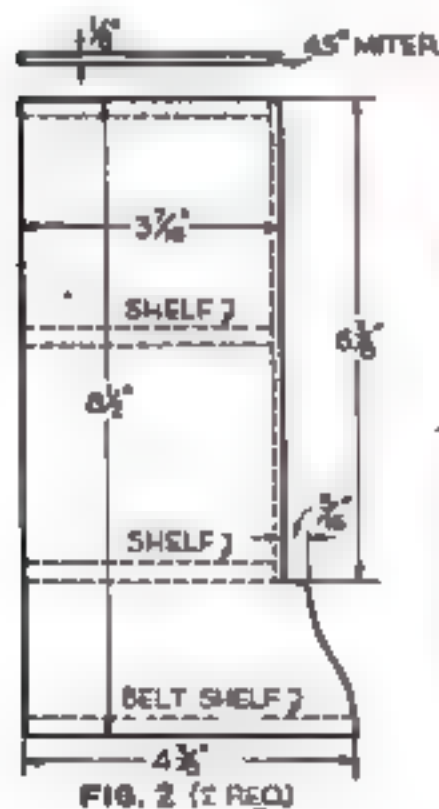
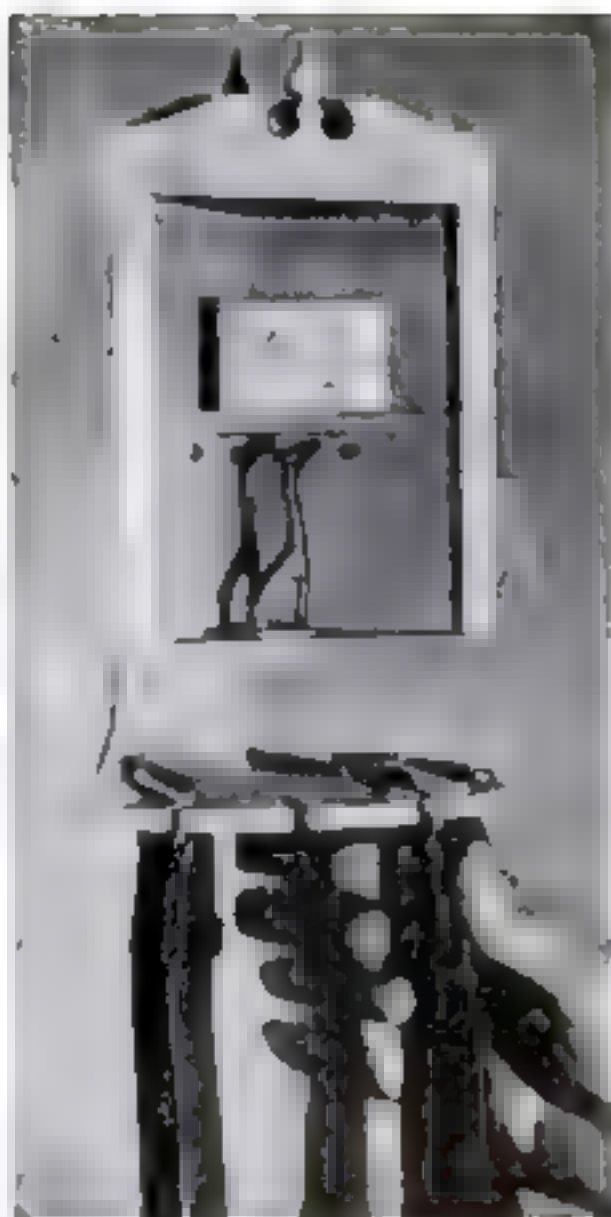
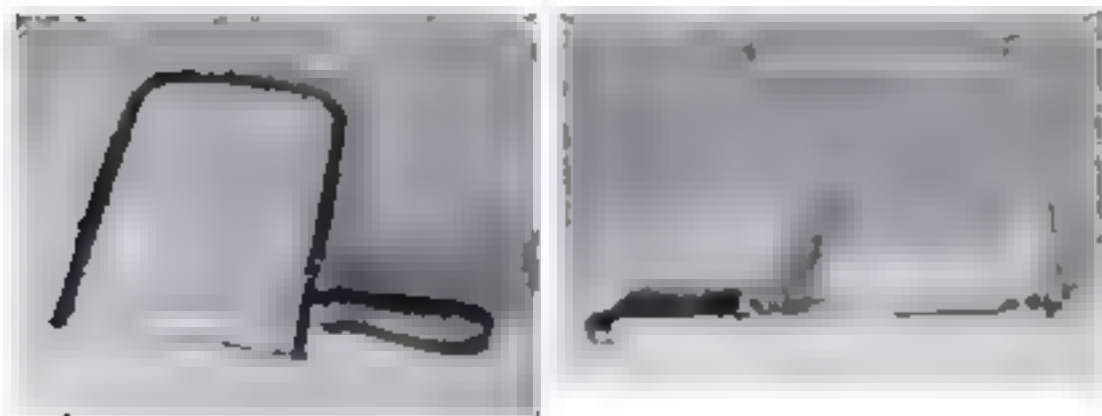


FIG. 5 (2 REQ)



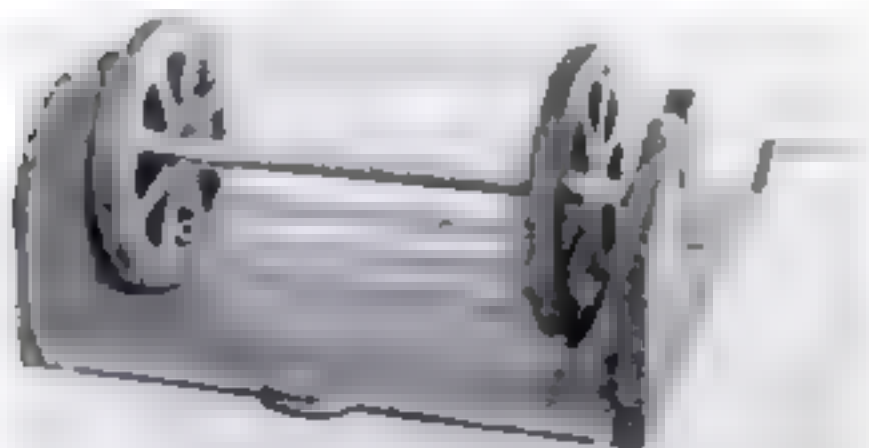
BOATING ENTHUSIASTS Donald L. Miller and J. M. Enyedy, of Pine City, N. Y., built this 17' cabin cruiser from P S M. plans. Because of wartime scarcities—both of material and of time—the boat took four years to build. A Brennan four-cylinder marine engine gives a speed of 10 m.p.h. with four passengers aboard. The exceptionally watertight hull is constructed from $\frac{3}{4}$ " mahogany and has battened seams.

CRAFTSMEN AT WORK



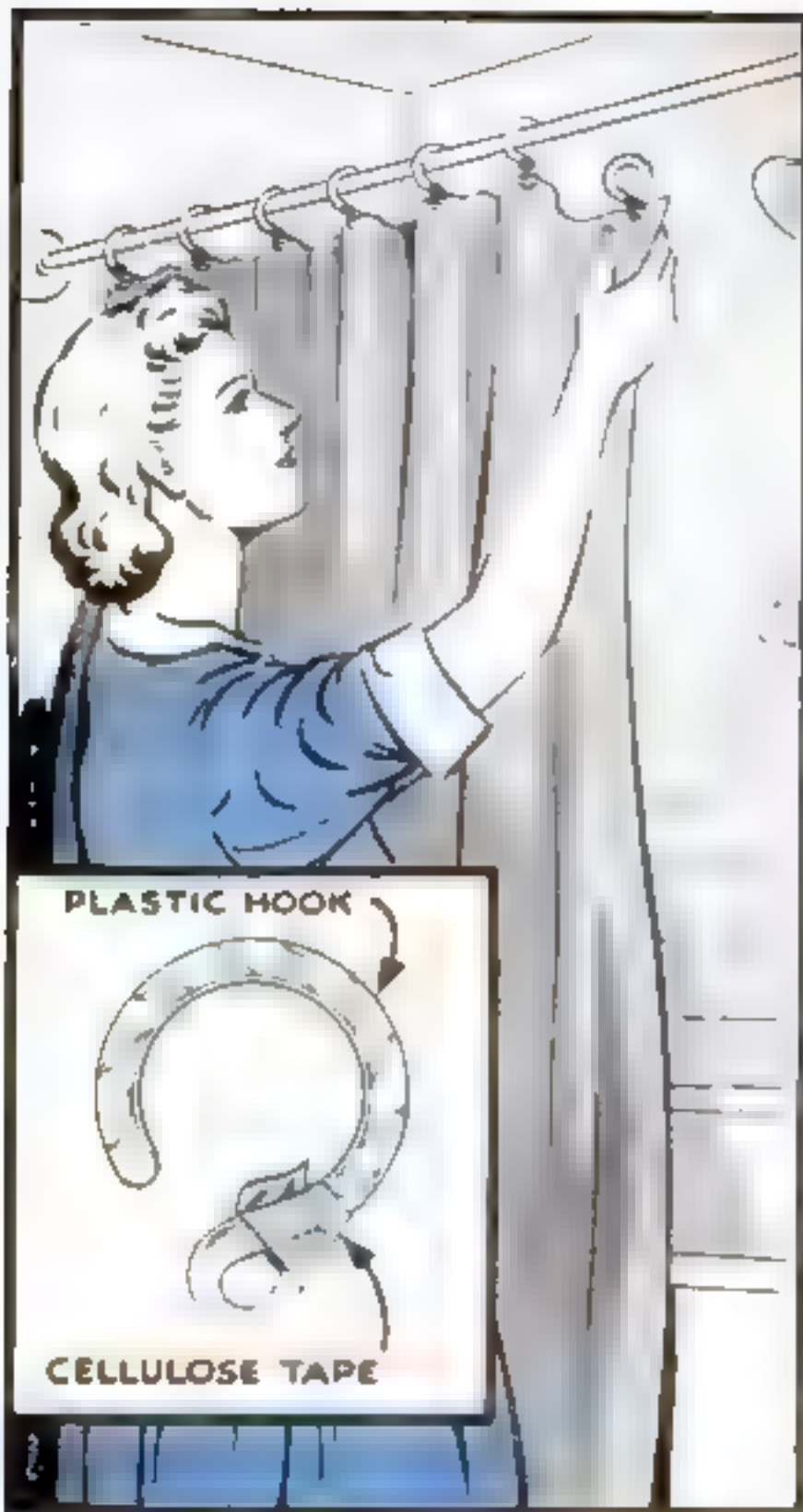
COPING SAWS for cutting large patterns have been developed by Dale Watson, mayor of Lasara, Texas. One has a hollow tubular extension frame so the depth of cut may be increased. The other has gears at the corners, permitting the blade to be turned at any angle while in the cut without twisting it out of alignment. Patents are pending.

SALT-WATER FISHERMEN will appreciate the fishing-line drier that is shown below. It was constructed of dowels, wood, and brass by J. N. DuBarry, of Villa Nova, Penna. The lower photo shows how it can be knocked down for easy transportation. It measures 18 $\frac{1}{4}$ " over all, has sufficient weight and size to be suitable for winding heavy lines, and has brass bearings.



ST. JEAN'S CHURCH, Quebec, has been reproduced in miniature by Gerald Duval, of Danielson, Conn. He spent his spare time for a year and a half building the 25" by 43" by 45" model. It has electric lights, a belfry with three bells, carpeted aisles, stained glass windows, and the same number of pews and statues as the original. A record-player inside plays organ music.

KEEPING

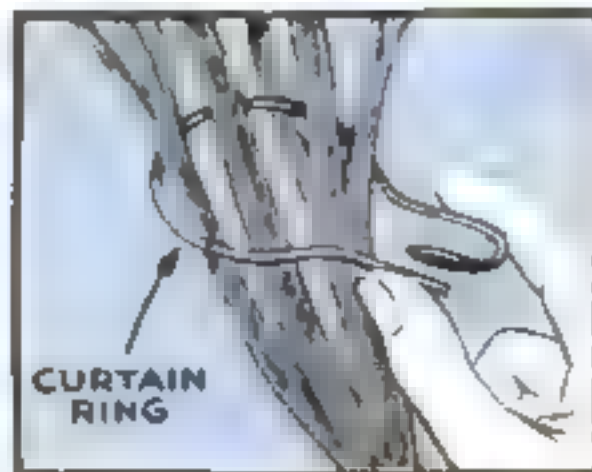


Eyellets on a shower curtain can be kept from coming unhooked from rigid plastic hangers if openings in the lower hooks are sealed with cellulose adhesive tape after insertion. This tape is waterproof and will not loosen in moist air, but it can be easily removed for taking the curtains down for laundering.

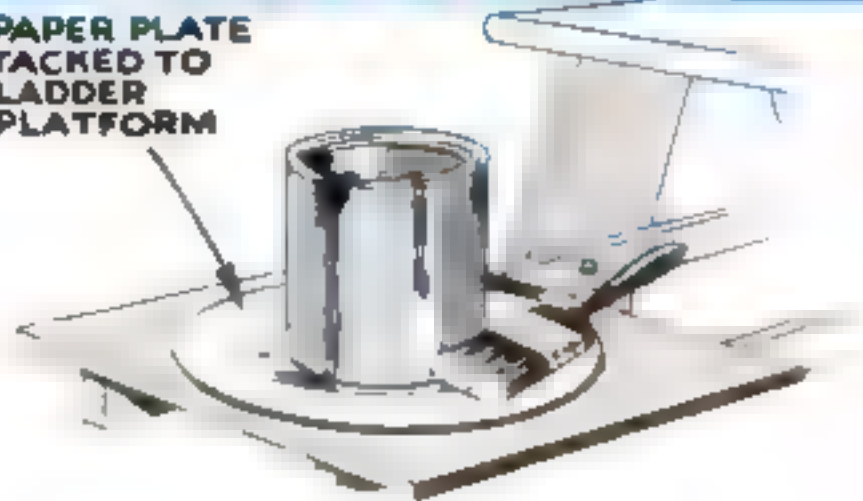
Disks of felt cut from an old hat, glued together in pads, and glued on the feet of a typewriter will overcome much of the clatter. Use at least five thicknesses in a pad.



Discarded shower-curtain hangers of the spring type will hold up vines and bushes while you mow a lawn. Clip them onto the mower frame when they are not in use.



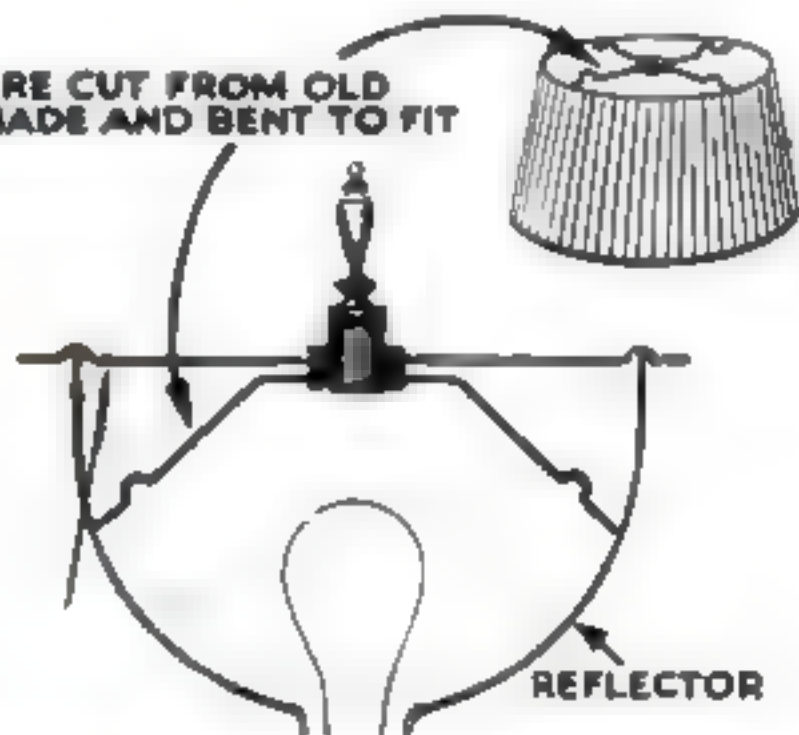
PAPER PLATE TACKED TO LADDER PLATFORM



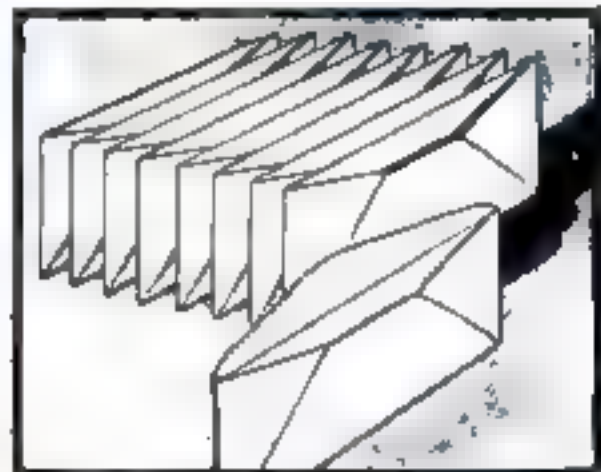
Tacked lightly to the folding shelf or platform of a stepladder, a picnic paper plate will keep sticky drippings from a paint can off the ladder and will also provide a place for laying down a wet paintbrush when time is taken out on the job.

Damage caused by accidentally knocking the shade off an indirect lamp can be avoided by using an anchor made of an old shade frame. Cut the wire longer than the reflector radius, tape the ends to prevent scratching, and bend them in as shown.

WIRE CUT FROM OLD SHADE AND BENT TO FIT

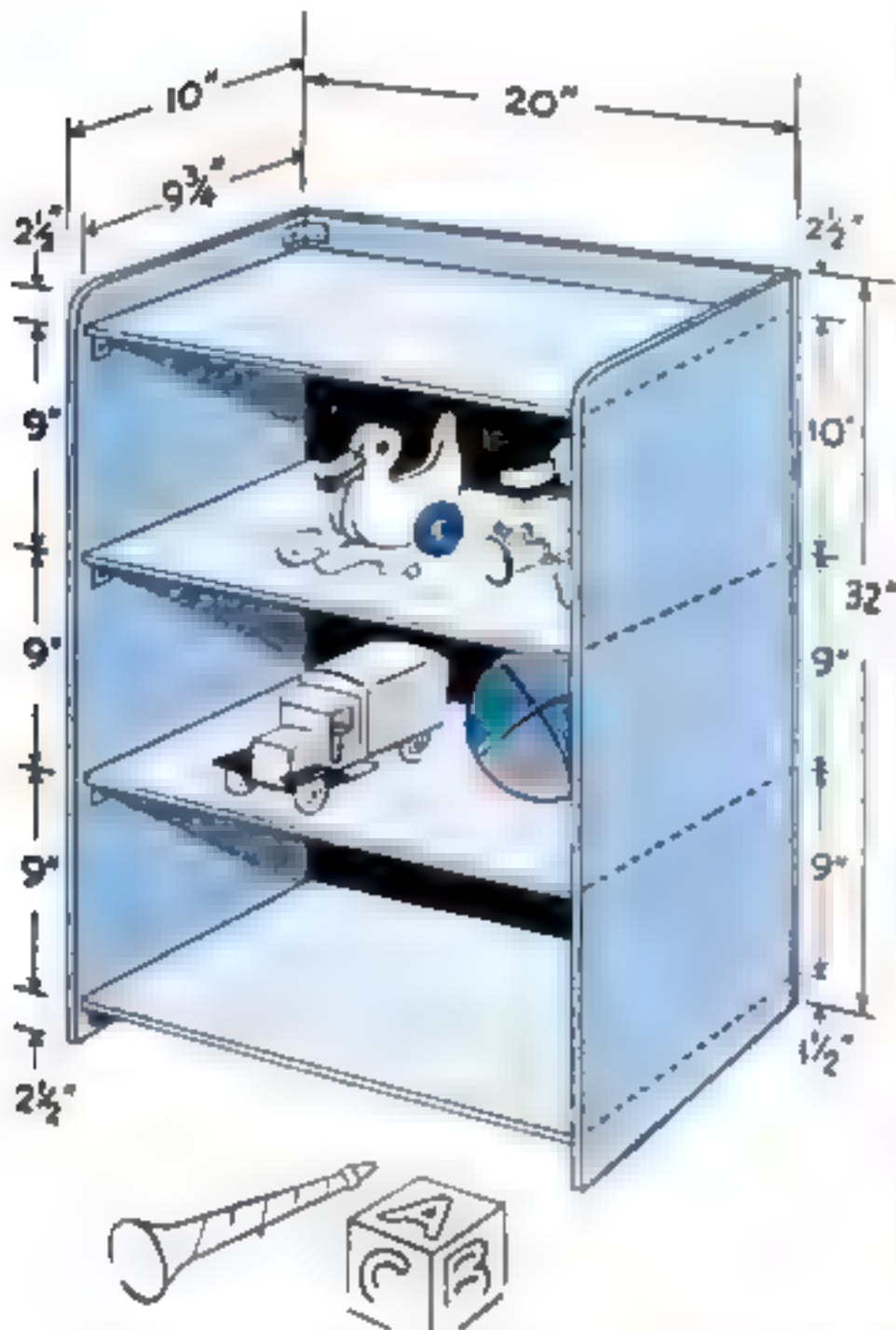


For a simple accordion file to hold small papers, bend back and glue the flaps of a stack of envelopes so that the first sticks to the second, and so on.



THE HOME SHIP SHAPE

Light, rigid composition board, joined with small angles held by bolts and nuts, makes an excellent cabinet for storing a child's toys. You can drill and bend scrap metal $\frac{3}{64}$ " or so thick for angles or purchase them at a hardware or dime store. Use four for each shelf and four at each edge of the back. All the shelves except the top slant toward the back so balls and wheeled toys can't roll off.



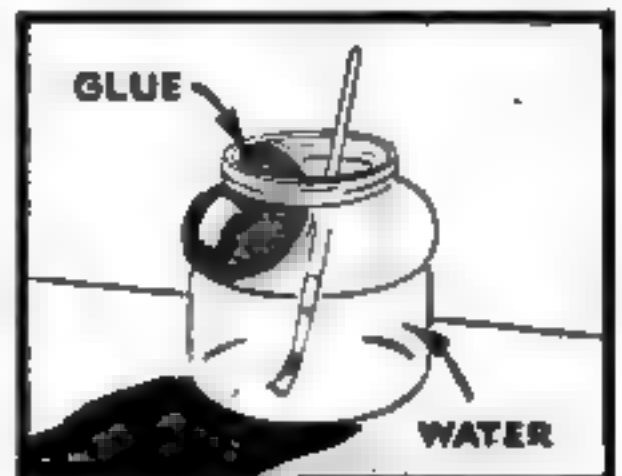
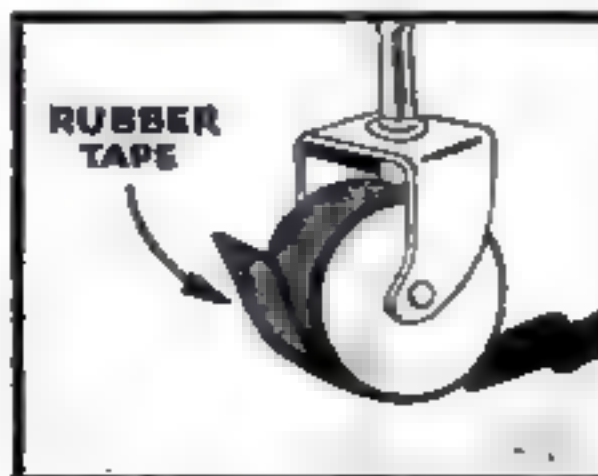
Old salt shakers make convenient dispensers for talcum or shaving powder. So do small jars having plastic caps. Simply drill $\frac{1}{16}$ " holes in each cap.

Two or three layers of rubber insulation tape—not friction tape—wrapped on the rollers of casters act as silencers when furniture is shifted in a room.

An ink bottle having a separate well for filling fountain pens is useful as a small glue pot. Put the glue in the well and water or other solvent in the main section.



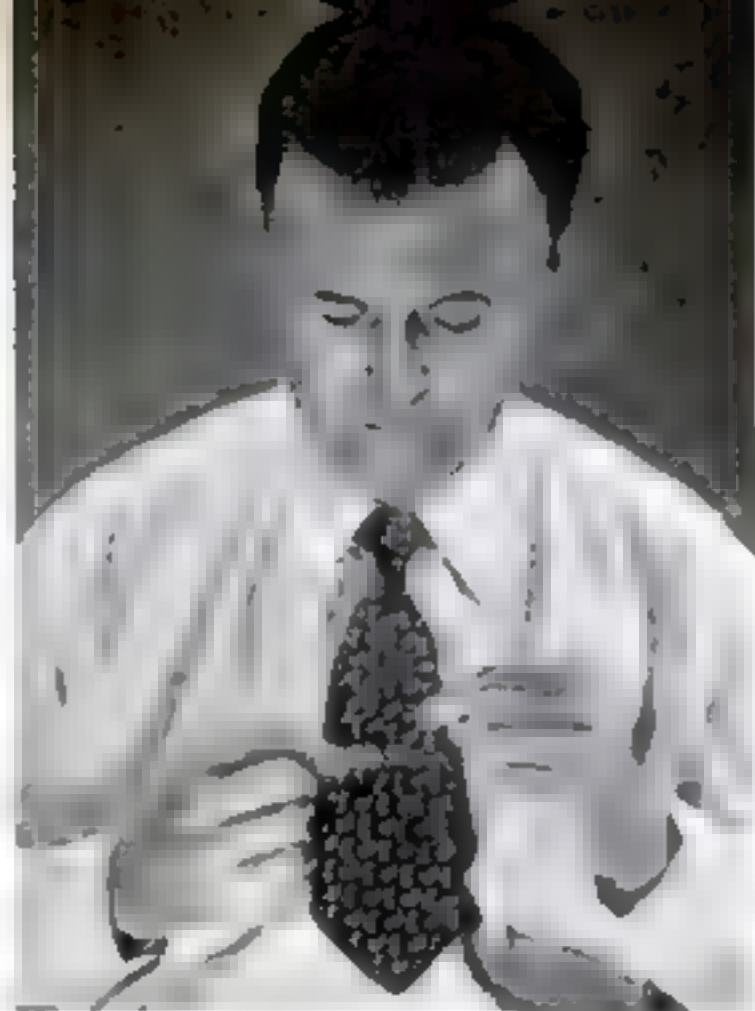
Providing an auto jack with an auxiliary lift bent from a piece of heavy strap iron, as shown, makes it useful for lifting large stoves, refrigerators, and the like for inserting bases under the feet or laying linoleum. The bend at the bottom should be near the floor so it will slide under low objects.



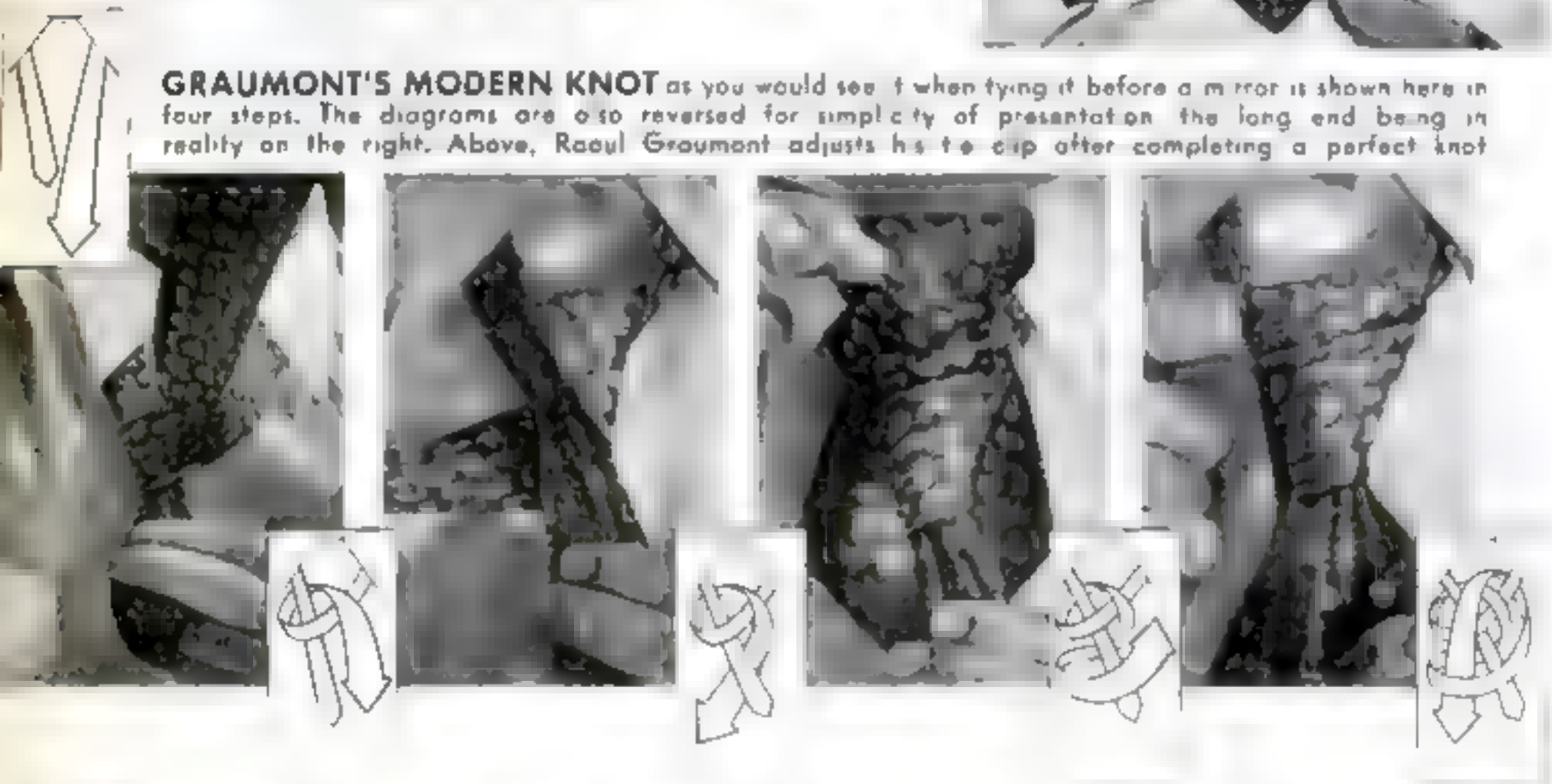
Solving a Knotty Problem with a Few Deft Turns

WHAT you do with your necktie when you stand in front of your mirror in the morning often means the difference between whether it stays put or needs adjustment whenever a blonde walks by.

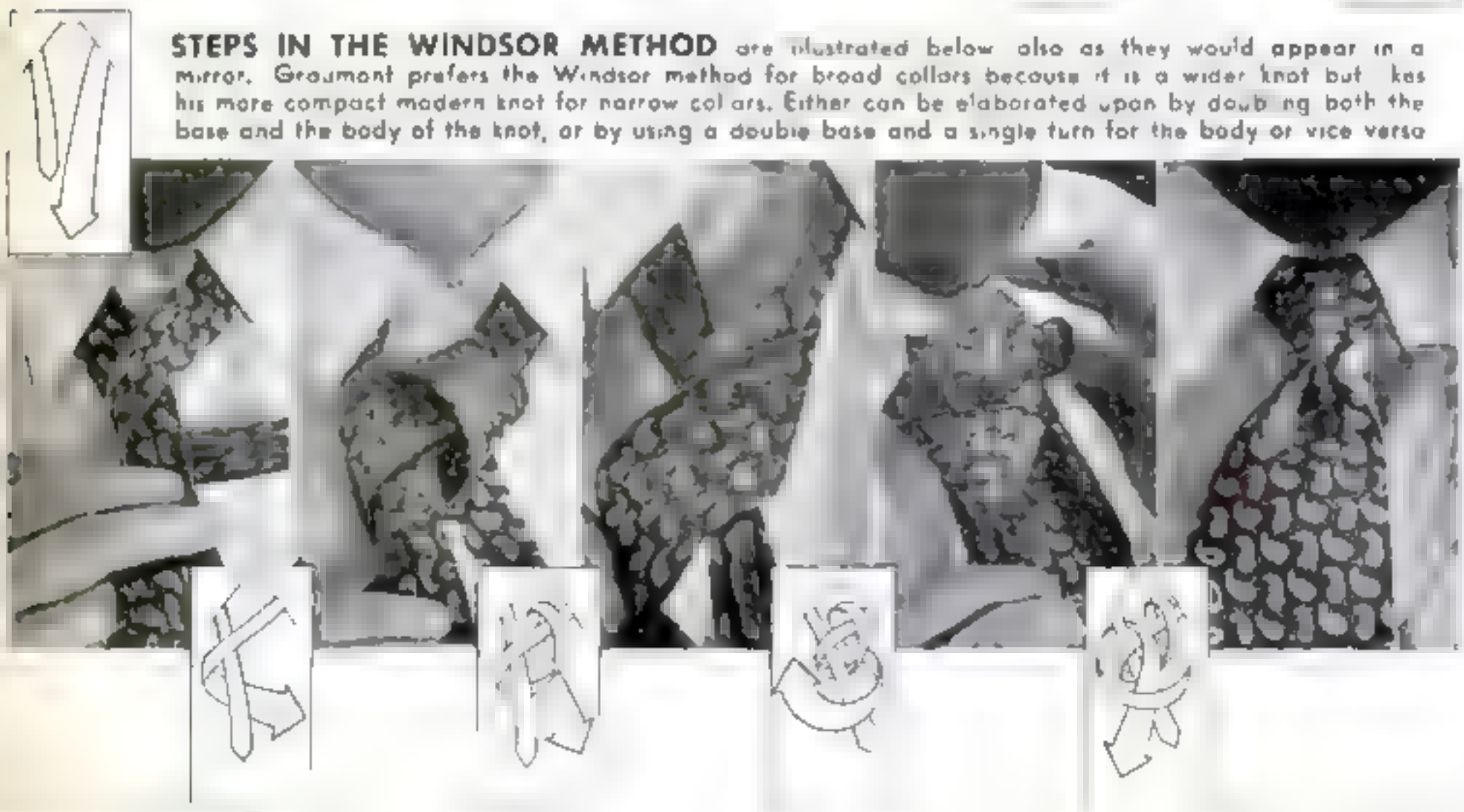
Raoul Graumont, of New York, author of the Encyclopedia of Knots, has made something of a study of knotting ties. He has himself devised a modern knot that not only stays put but also has the additional advantages of not crumpling a tie excessively and of not jamming when it is slipped down for taking the tie off without untying it. It is shown below with the Windsor knot. Both are similar to the old four-in-hand knot except that each of them makes use of a half hitch for the base.



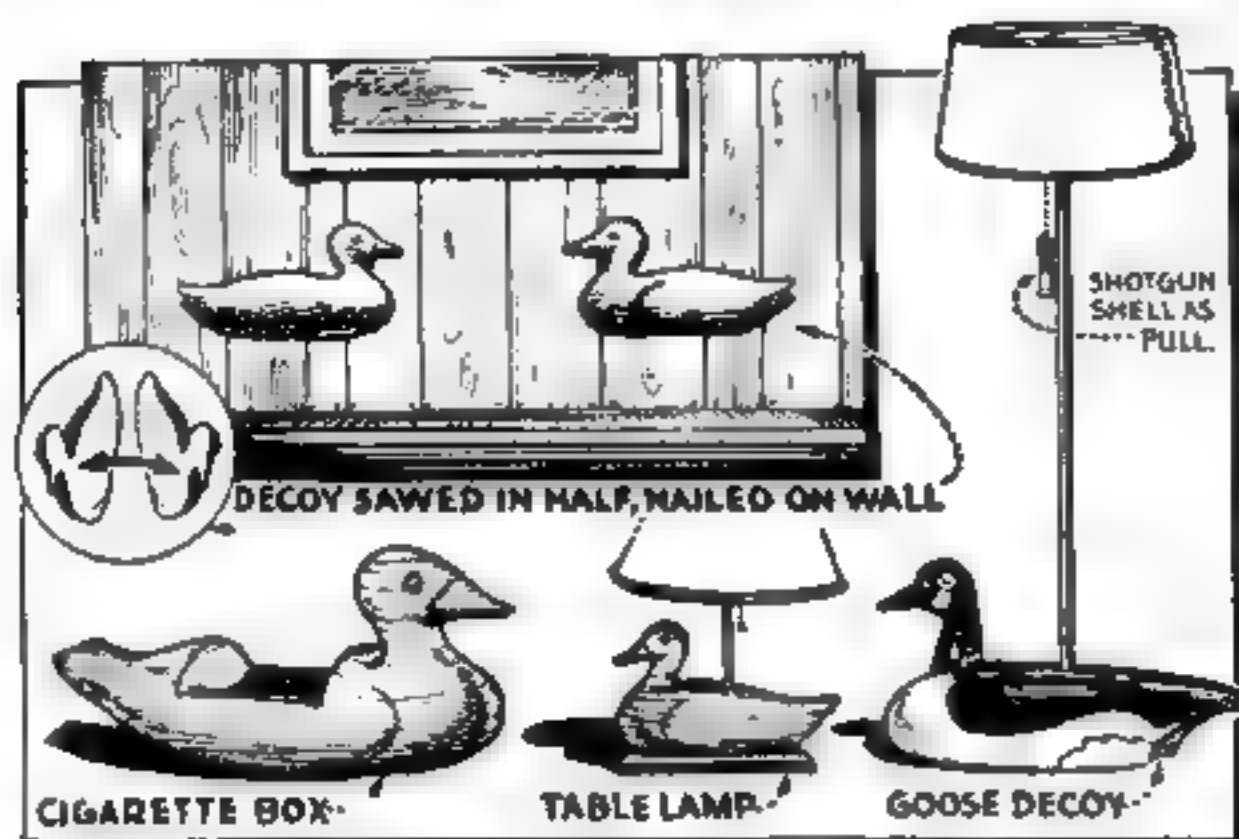
GRAUMONT'S MODERN KNOT as you would see it when tying it before a mirror is shown here in four steps. The diagrams are also reversed for simplicity of presentation, the long end being in reality on the right. Above, Raoul Graumont adjusts his tie clip after completing a perfect knot.



STEPS IN THE WINDSOR METHOD are illustrated below also as they would appear in a mirror. Graumont prefers the Windsor method for broad collars because it is a wider knot but uses his more compact modern knot for narrow collars. Either can be elaborated upon by doubling both the base and the body of the knot, or by using a double base and a single turn for the body or vice versa.



Discarded Decoys Attractive for Decorating a Country Home



TRUE examples of practical American art are the familiar well-shaped game-bird decoys, such as those made to represent the duck, gull, sandpiper, goose, or curlew. An old decoy can easily be adapted for use as a mantel decoration, cigarette box, or lamp, as shown at the left. Other possibilities will probably occur to you. If the paint has faded, don't repaint—that would hide the "antique" value—but clean the decoy with a wire brush; then varnish.—IVAN MUNDA.

Archery Sight Permits Snap Shooting at Different Ranges

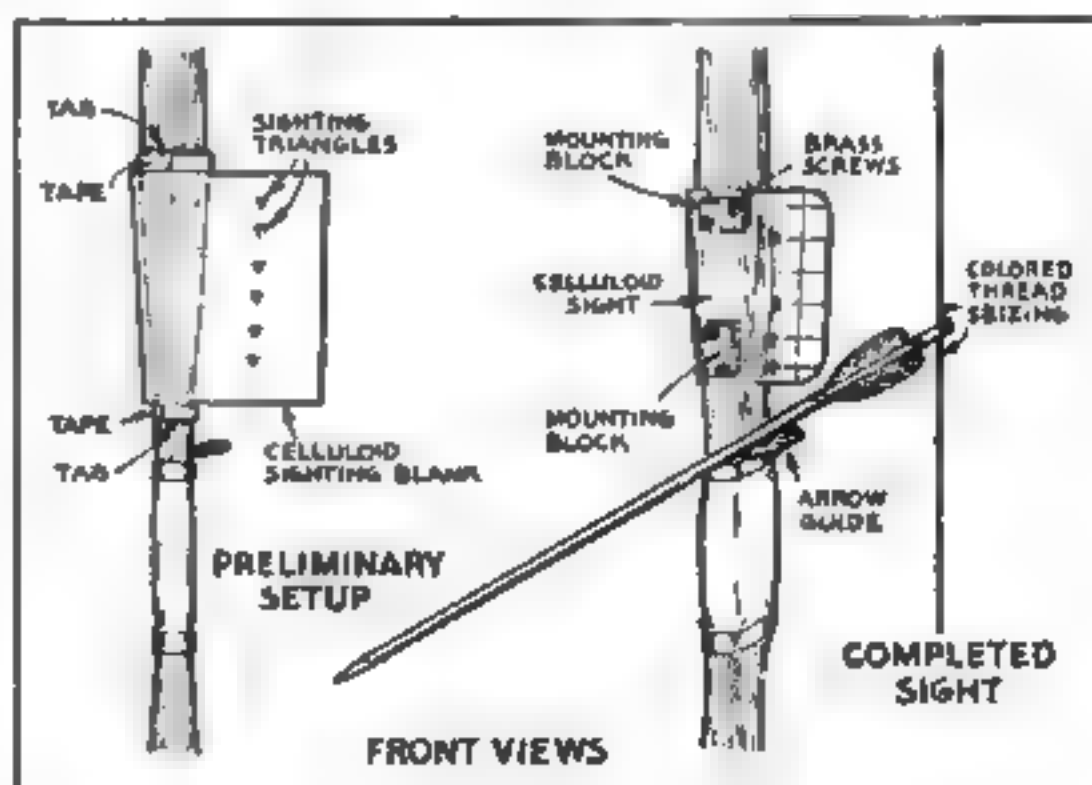
Bow sights that can be set for a fixed range are commercially available, but a sight that may be used instantly, without adjustment, at any range, doesn't lend itself to mass production because the sight markings will be affected by the size and build of the archer, the cast of his bow, and the weight and construction of his arrows. So a sight like the one illustrated must be custom-made to suit the individual.

Seize the string at the two points shown as a guide so the arrow will always nock at the same place. Glue a small block of hardwood, for an arrow guide, to the side of the bow—at right angles to it but inclined slightly upward at the outer end. Place the nocking guide and the arrow guide so the tip of the arrow will be slightly higher than the nock when in shooting position.

As a calibrating sight, cut a celluloid blank and tape it to the bow as shown at the left in the drawing. For sighting points, use small inverted adhesive-tape triangles. A 30-lb. bow should have one for every five yards up to 20; then for every 10 yards up to 40. Conduct preliminary shooting tests on a windless day. Stand at the preselected distances from the target and, by trial and error, set the triangles in approximately the right positions. Always draw your right hand to the same point before releasing the arrow. A con-

venient point is that where the joint between your thumb and hand lies directly under the right side of your chin.

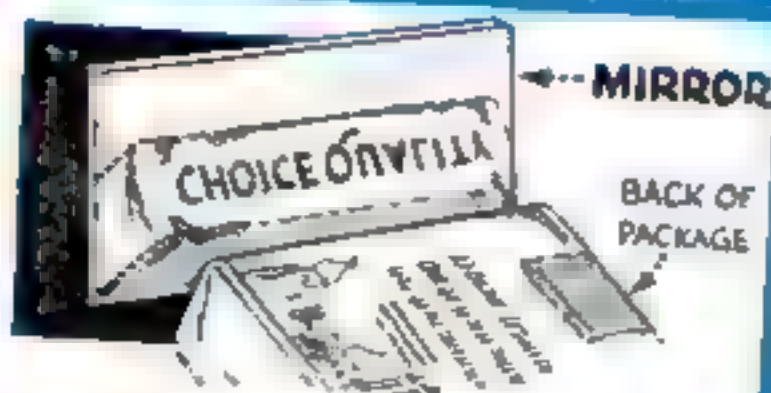
The finished sight, also celluloid, is smaller, of course, than the sighting blank. It is fastened in place with two $\frac{1}{4}$ " hardwood blocks. Secure a set of adhesive-tape triangles to it so they match those on the sighting blank. Glue the mounting blocks to the bow and fasten the sight to the blocks with small brass screws. Then go out on the range and carefully check the positions of the triangles. They will lie in a line not quite parallel to the axis of the bow. Score this line, then a series of crosslines, through the points, taking care to draw the latter at right angles to the axis of the bow. Fill in with India ink.—JOHN L. STORY.



FACTS FOR FUN!

Tricky Tricky
Add Spice to Party

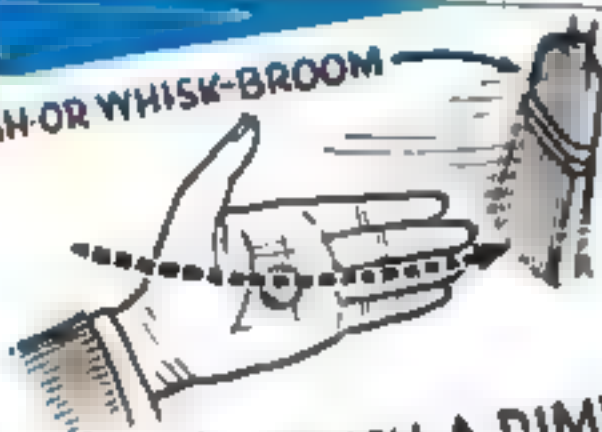
1



WORD "CHOICE" ON CAMEL PACK READS CORRECTLY IN A MIRROR.

2

BRUSH OR WHISK-BROOM



YOU CAN'T BRUSH A DIME FROM OUT OF YOUR PALM!

3



YOU CAN SHAKE A DIME RIGHT THROUGH A MILK BOTTLE!

4

ONCE

TWICE

YOU CANNOT FOLD A PIECE OF PAPER MORE THAN TEN TIMES!

5



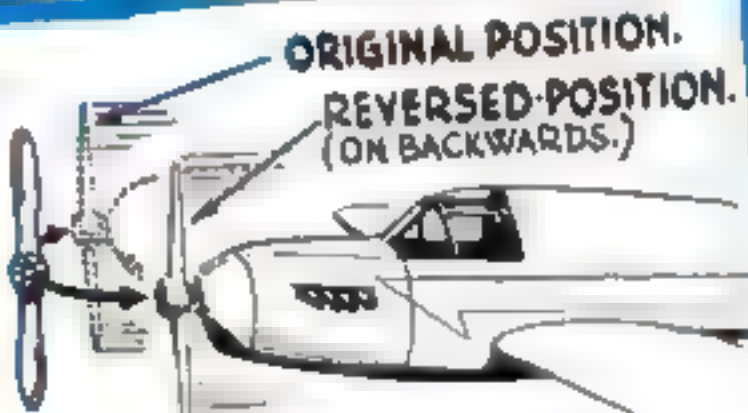
THERE'S A WORD ON BACK OF A CAMEL PACK THAT CAN'T BE COVERED BY A QUARTER!

6



YOU CAN TIE A CIGARETTE IN A COMPLETE KNOT!

7

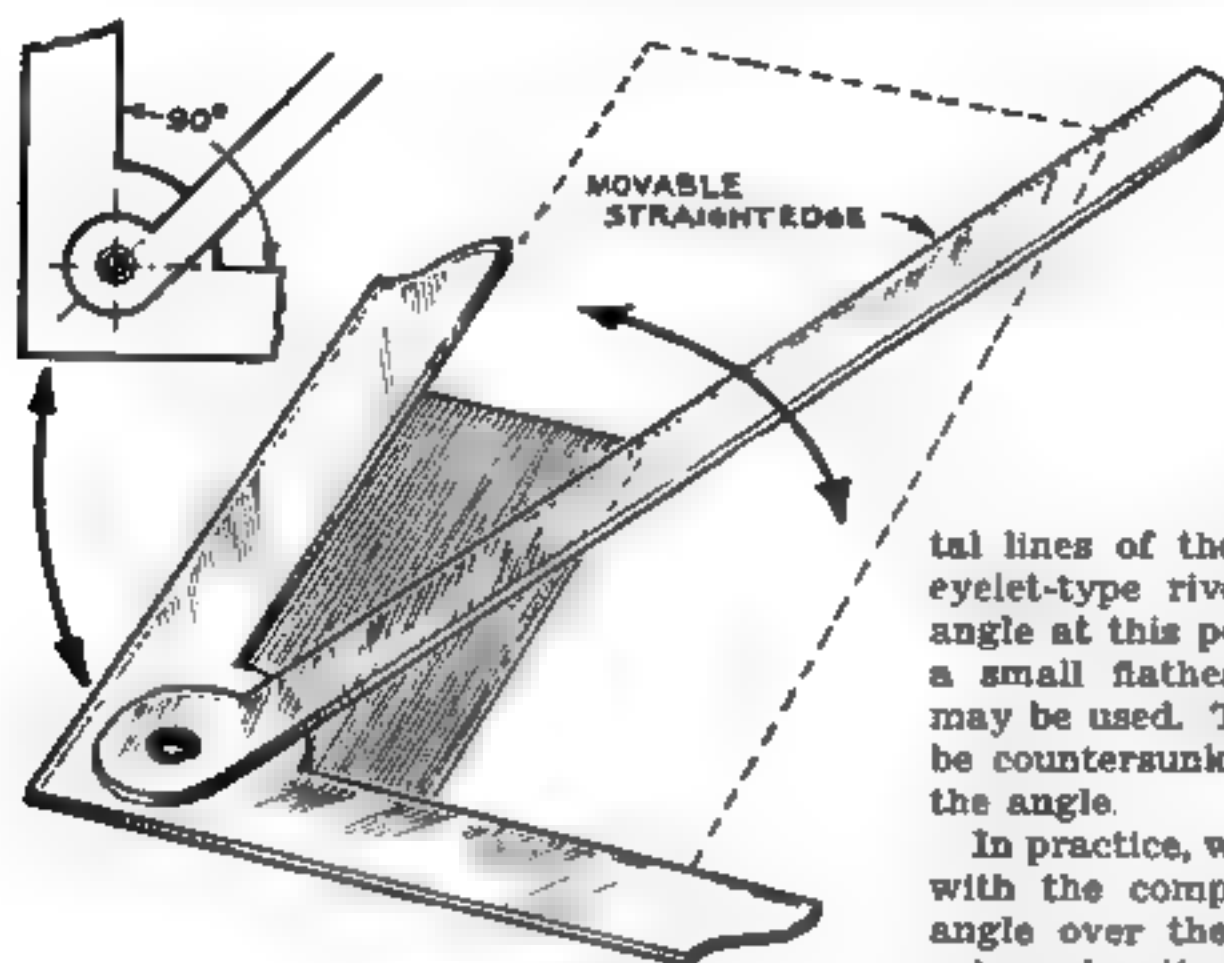


IF YOU REVERSE A PROPELLER IT STILL PULLS THE SHIP AHEAD!

4. It doesn't matter how big a piece you start with, but remember that each fold must halve the area of the paper.
5. The word "prohibits," which starts on one line and ends on another.
6. Wrap a cigarette tightly in cellophane, twisting the ends of the wrapper shut. After pulling the knot tight, you can open it and show the cigarette undamaged.
7. The direction of thrust remains the same, although the camber will be on the wrong side for best efficiency.

1. First hold the pack with the face up. Then say that you can turn one word right side up at will—and turn the pack over as shown.
2. You can bet the dime on this. But use an old one and a worn brush or whisk broom.
3. The bottle must be quite dry inside. Holding it with both hands, swing it hard in an up-and-down arc. Don't let the dime circle around inside. The right motion rings it out, making a small hole in the bottle.

Handy Angle Reduces or Enlarges Drawings



THIS handy angle enables one to determine quickly, and with accuracy, the proportions of photographs or drawings for enlargement or reduction. To make the instrument, cut the legs of a 90-deg. angle from thin plastic, wood, sheet aluminum, or brass. Whatever the material used, it is

important that the inner edges of the legs form an accurate right angle.

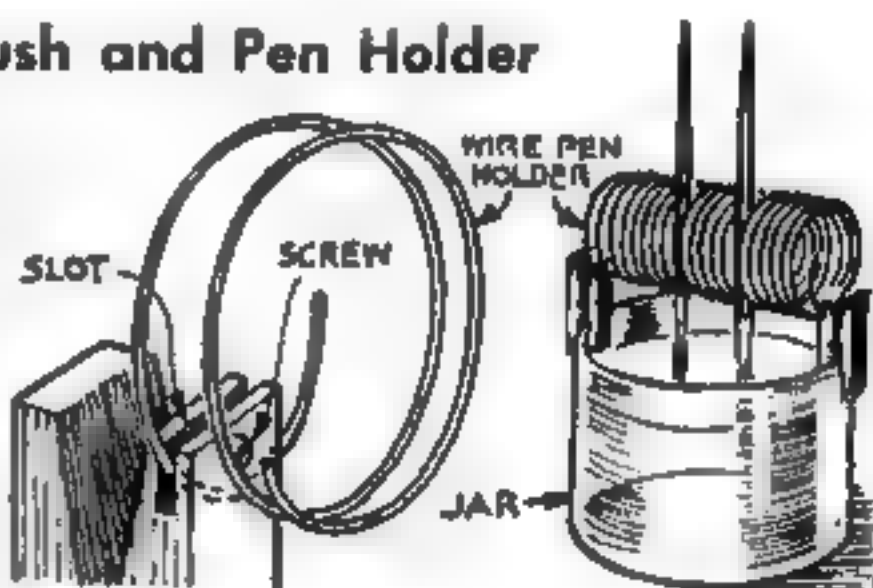
Enough material should be left at the junction of the legs to permit mounting a pivoted arm, as shown. Make the arm from the same material used for the angle. When the arm is completed, it is pivoted at the exact spot where the vertical and horizontal

lines of the inner angle intersect. An eyelet-type rivet driven through arm and angle at this point will serve as a pivot, or a small flathead machine screw and nut may be used. The head of the screw should be countersunk flush with the underside of the angle.

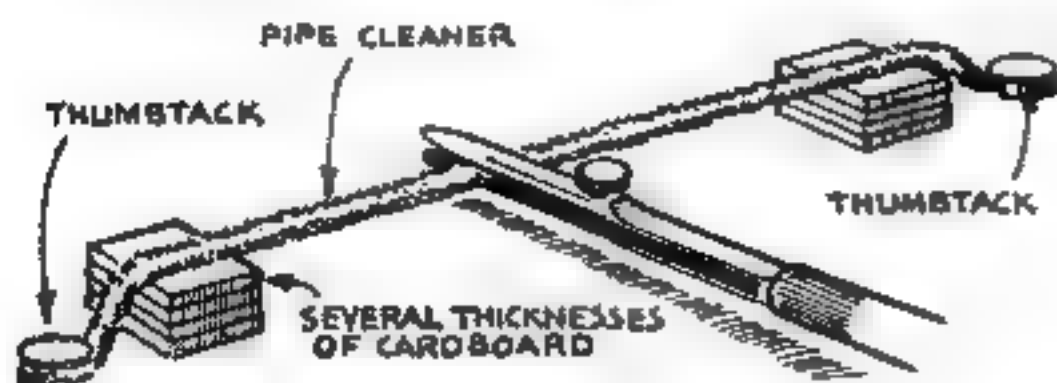
In practice, when determining proportions with the completed instrument, place the angle over the drawing to be reduced or enlarged so that the inner edges of the angle are flush against two edges of the drawing. Then, using the movable arm as a diagonal, intersect the opposite corner of the drawing. Draw a line along the diagonal to the desired point, then draw two lines from this point at right angles to the lines formed by the inner edges of the legs. The resulting square or rectangle will be of the correct proportions.—C. W. B.

Clips and Wire Coil Make a Brush and Pen Holder

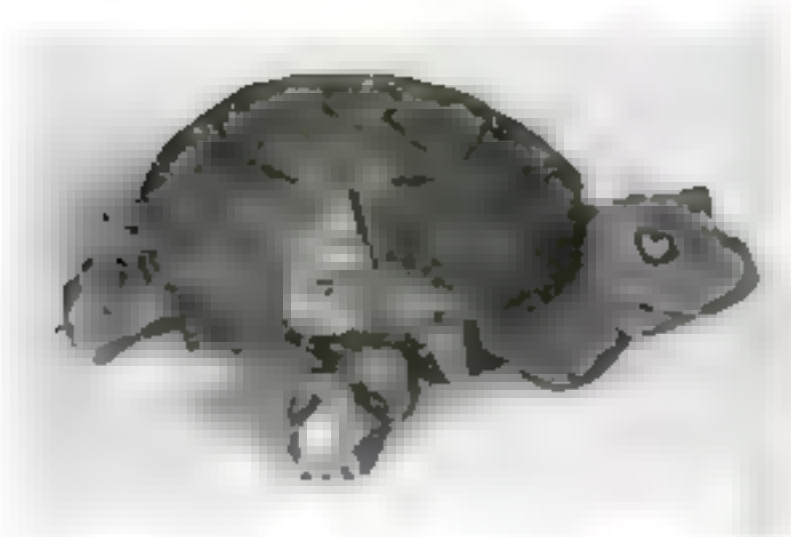
A WIRE coil, bought at an artist's supply or stationery store, and a few odds and ends create an improved holder for brushes and pens which will keep them clean and out of the way. Cut enough wood from the ends of two spring-type clothespins so that the shortened pins are approximately $1\frac{1}{2}$ " long. Slot one prong of each pin with a saw, insert the coil ends in the slot, and secure with wood screws. The clothespins are then clipped to a water-filled jar.—M. A. J.



Pipe Cleaner Tacked to Drawing Board Forms Draftsman's Pen Wiper



ANY desk contains most of the materials necessary to make a very simple pen wiper, ideal for use by draftsmen and architects. Obtain a few pipe cleaners of the wire-core variety. Cut thicknesses of cardboard to make two blocks as shown. Then stretch a pipe cleaner over both blocks, and fasten down the ends with thumbtacks. When the cleaner wears out, simply pry up the tacks to replace it.

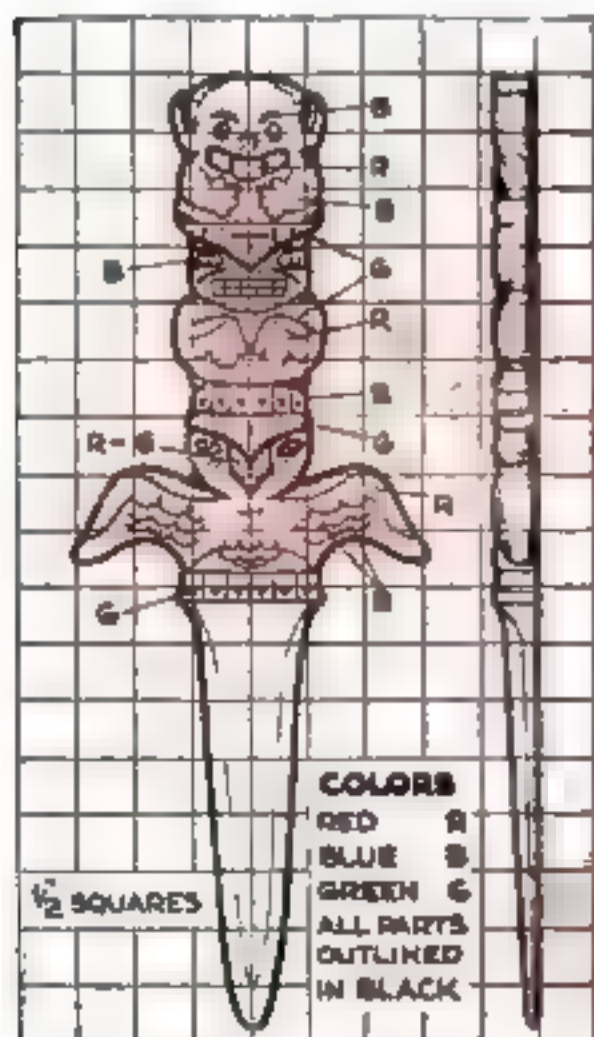
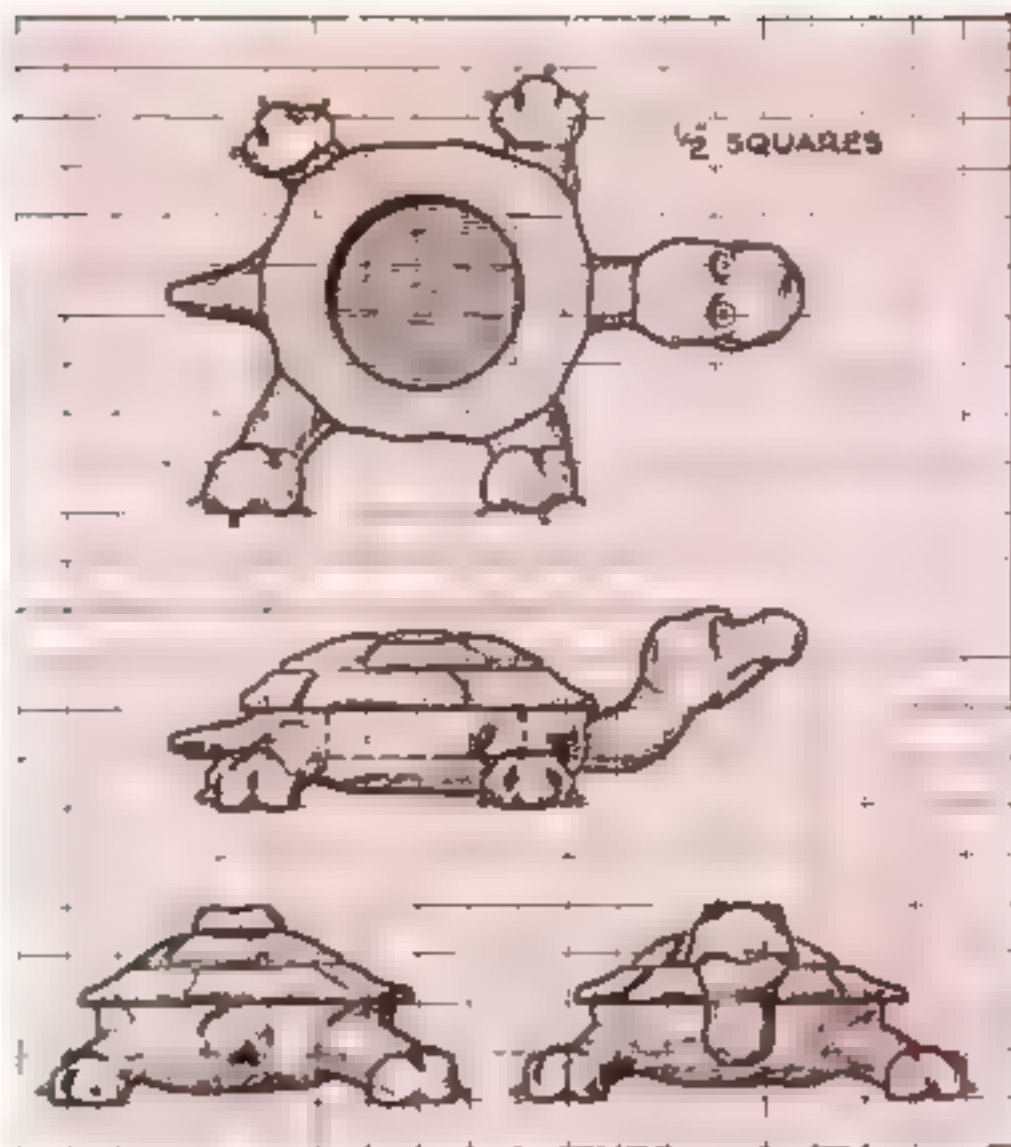


Carved Turtle Box Holds Small Desk Accessories

THEOBALD the turtle would have you believe he is on his way. But he gets nowhere fast—no further than the top of your desk, where he holds paper clips, stamps, or other small articles.

This is a jackknife job. Lay out the three parts—the shell, the body with the legs, and the head and neck—on any soft wood 1" thick. Make the box section on a lathe or by hand with a mallet and chisel. An oblong cavity is possible if the work is done by hand. Jigsaw the legs, and then use your jackknife, turning the work often to keep the proportions correct. Don't round off the knife cuts, since they add effectiveness.

Sand the pieces lightly, glue and dowel the neck, and hinge the lid; then apply walnut stain, rubbing off the excess to give the carving a weathered look. Brush a little green enamel on the top, legs, and head, and rub it off with a cloth, leaving a faint, mossy tinge. Add toenails and eyes last. The former are short lengths of round toothpicks fitted into drilled holes. They are left white. The eyes are white map tacks with the pupils painted in black.—ELMA WALTNER.



Gay Paper Knife Has Totem-Pole Handle

THIS novel paper knife will be useful on a desk either at home or at the office. Carve it from $\frac{3}{4}$ " thick hardwood—birch, maple, or another that is light in color and can be whittled without too much difficulty. A paper pattern will be symmetrical if half is drawn first and the paper is then folded lengthwise and cut out.

Saw the outline roughly and then proceed with the carving. Round the edges a trifle, emphasizing the figures with carved lines. The back is simply rounded at the edges to provide a comfortable grip. Thin down and sharpen the blade with sandpaper and sand the entire piece lightly.

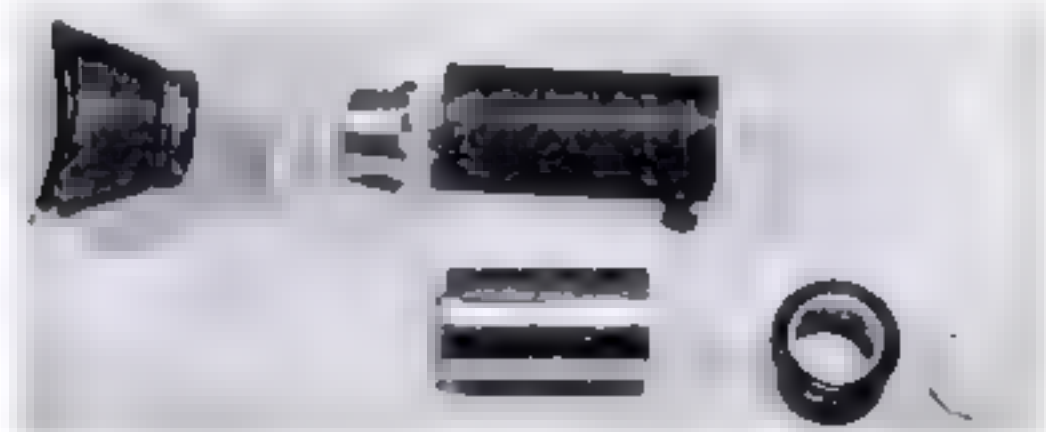
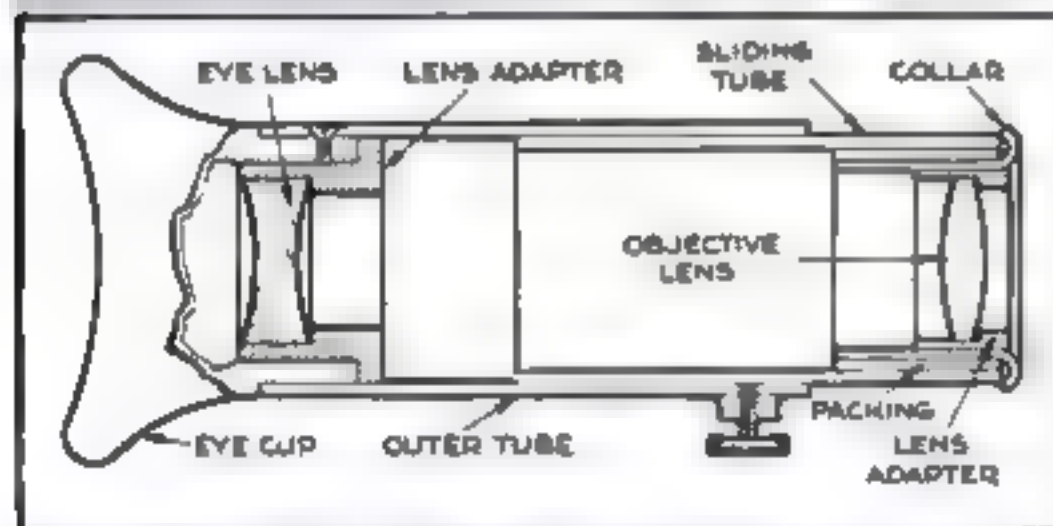
Finish with clear varnish, rubbed with steel wool after it has dried; then apply colored enamels to accentuate the natural wood. Draw in the features with a pen and India ink when the enamel has dried. Add two protecting coats of wax.—E. W.



Building a Pocket Telescope from an Exposure Meter



Quickly adjusted for focus, the finished telescope may be carried in a pocket for use both in and out-of-doors. Photos and diagram show neat appearance and simple construction



MANY people, especially sportsmen and theatergoers, have use for a small, efficient, but inexpensive pocket telescope. To make one, all you need is an old exposure meter of the extinction type, or a similar one having a tube, plus a pair of salvaged lenses and some paper and glue.

The telescope shown has a magnifying power of four diameters. It is of the Gal-

lean or opera-glass type, the optical system consisting of a positive lens of about 4" focus and $\frac{3}{8}$ " diameter for the objective, and a negative lens of approximately 1" focus and $\frac{3}{8}$ " diameter for the eyepiece. The objective in this case is an achromatic doublet, which, being corrected for color, produces sharper images than a simple lens. Such achromats may be obtained from old opera glasses or other optical instruments, or may be purchased for a reasonable price from dealers in salvaged lenses. The objective lens should have as large a diameter as the meter tube will permit, though usually the builder must use whatever diameter is available.

To convert a meter of the type shown into a telescope, remove all the screws and separate the sections. You will have a cup-shaped eyepiece, a body tube, two nicked tubes, and a rolled-edge collar, $\frac{3}{8}$ " long from the outer end. Discard the section that holds the iris diaphragm, but keep the one having the longitudinal slot. Force out the disk that is in one end of this tube. Remove the magnifying lens from the cup-shaped eyepiece and replace it with the negative lens. Reassemble the eyepiece and body tube; then replace the slotted tube so it is reversed with respect to its original position. Mount the objective lens in the rolled-edge collar and insert the collar into the outer end of the slotted tube, using cardboard and quick-drying cement as a packing.

The best method of fastening the lenses in position is to machine brass adapters, if you have the facilities. An alternate method is to use wood putty, or strips of paper and glue, to build up a suitable mounting.

The telescope has a $1\frac{1}{2}$ " focusing movement, which is operated by sliding the slotted tube forward or back. The knurled-head screw in the body tube locks both tubes together to maintain focus.

For convenient carrying, shorten the original leather case to fit the telescope, and restitch the bottom.—ERVIN WALTERS.





KINGCOBRA IN MINIATURE

The P-63 . . . Bell's Superb New Fighter and Low-Level Strafer

THE Kingcobra is a larger, improved version of its famous older brother, the reliable P-39 Airacobra. Its greater speed, faster rate of climb, higher ceiling, and increased combat range are achieved by using a bigger engine—the P-39 has a 1,150-hp. Allison and the P-63 has one of 1,500 hp. This increase in power has necessitated using a four-blade propeller instead of the three-blade one used on the Airacobra. Both planes have the same armament—a 37-mm. cannon that fires through the propeller hub, two nose-mounted .50-cal. machine guns that are synchronized with the propeller, and a .50-cal. machine gun under each wing. Both feature a rear-mounted engine and excellent forward visibility. The Kingcobra has a low-drag laminar-flow wing.

Reproduced on the facing page are half-size plans of the model. Connect the graduations at the edges of the page to form a grid of $\frac{1}{4}$ " squares. On a large sheet of stiff paper, lay out a grid of $\frac{1}{4}$ " squares; then transfer the lines from the small grid to the large one by matching squares. Draw a second, similar full-size layout and cut out the shapes to form patterns.

Carve the fuselage from a piece of $\frac{3}{4}$ " by $1\frac{1}{2}$ " by $7\frac{1}{2}$ " balsa, pine, or other soft wood, using the fuselage-section patterns as guides. Cut out the belly to take the one-piece wing. Use a $\frac{3}{4}$ " by 2" by $9\frac{1}{2}$ " blank for the wing, carving and sanding it to the form that is indicated by the wing-section patterns. Score and crack it at the two places where the dihedral starts. Resting the center section on the bench, raise the tips to the proper angle, support them with blocks, and cement the cracked pieces.

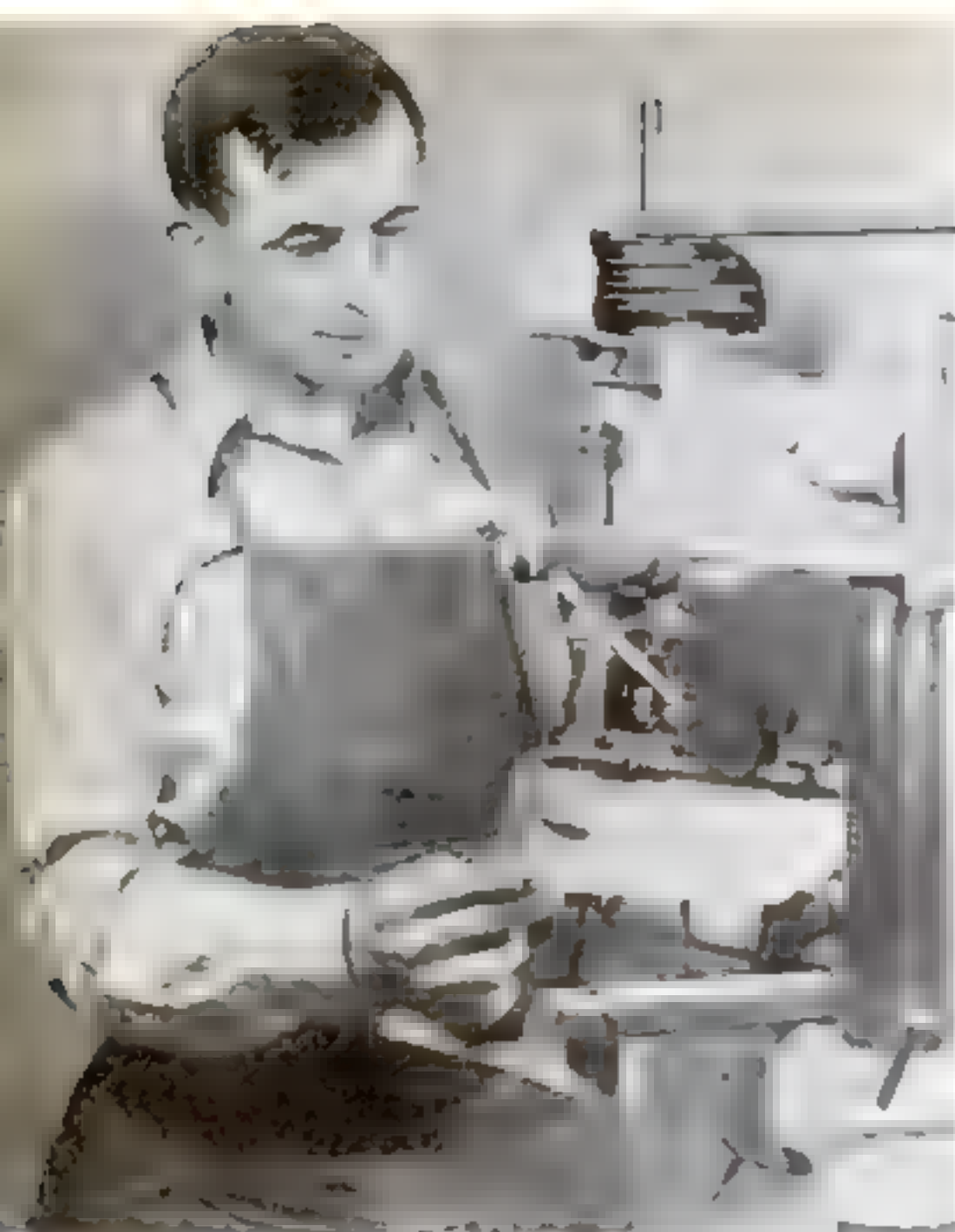
Fabricate the stabilizer and the rudder from $\frac{1}{4}$ " stock.

Thoroughly sand each part; then assemble the model, using glue or cellulose cement to hold it together. Form the fillets at the intersections of the wing and the body with plastic composition wood. Make the machine guns and the wing-tip lights from scraps of wood and glue them in place. Cut the propeller disk from celluloid. To make it seem to be whirling, pin it through the center to a piece of sandpaper; then rotate it so the sandpaper scores it. Secure it to the model with a shaped wooden hub and a brad.

Finish the model with several coats of wood filler and a coat of camouflage paint.

Distinctive ground features of the P-63 include a four-blade propeller and a retractable tricycle landing gear





Grinding off the sides of the wing nuts and providing a washer bar speed the setting up of a drill-press fence

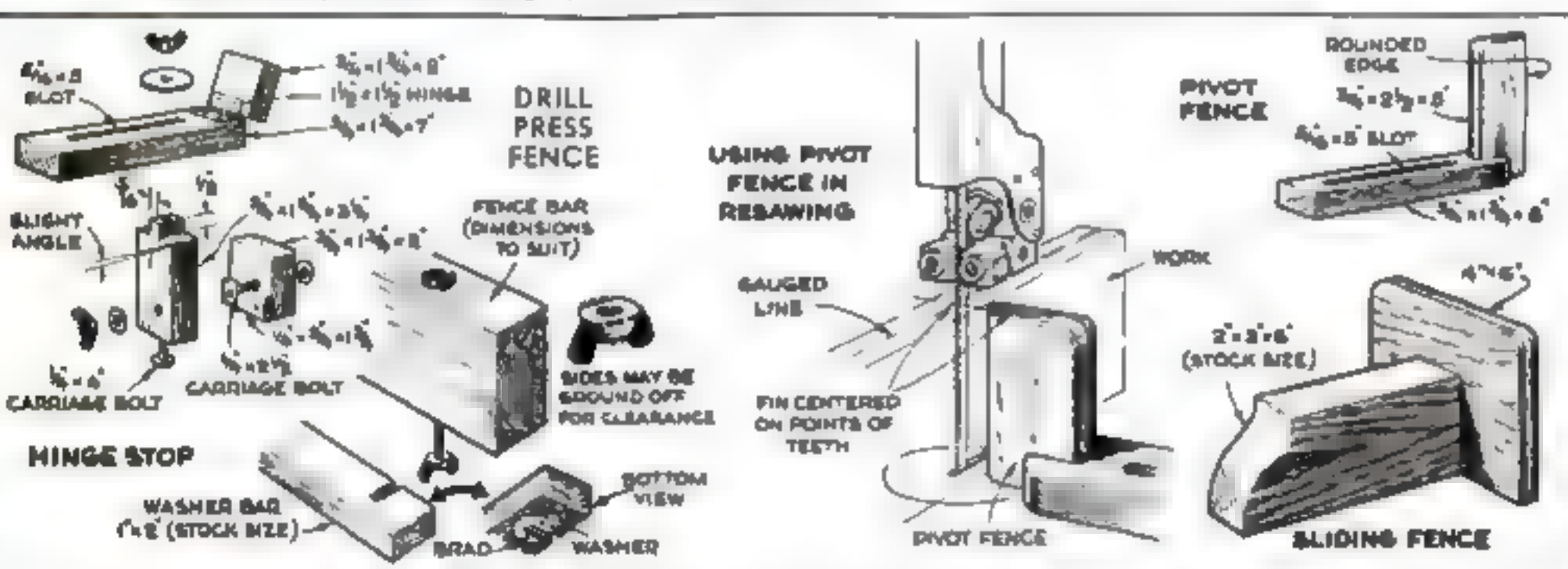
Machine Aids

By Edwin M. Love

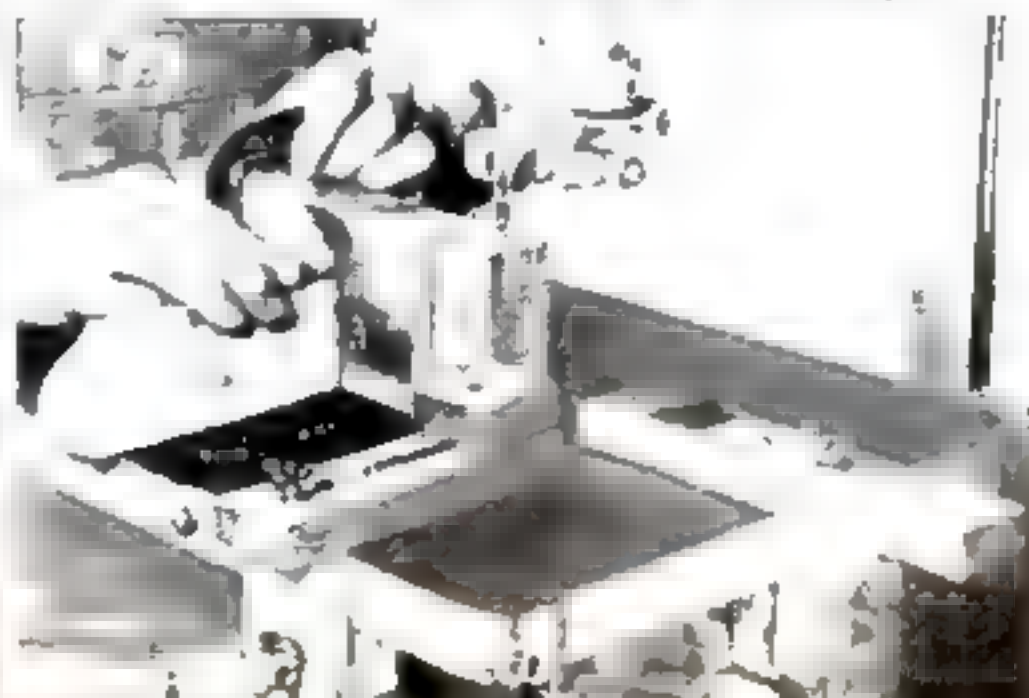
WHEN timesaving is an important factor, it will pay you to build adjustable machine attachments that will be useful year in and year out. They will end the necessity of hunting for suitable blocks and clamps—not always conveniently at hand—every time stops and the like are needed, and should be welcome not only in the shop operated for profit, but also in the home workshop where even a few minutes gained at the start add to an evening's enjoyment.

Several especially useful attachments are shown in the accompanying photographs and drawings. They include a pair of hinged stops, a quick-clamping drill-press fence, pivot and sliding fences, high and low auxiliary fences for the circular saw, a lathe semaphore, and a steady rest.

How are hinged stops made? One is shown at the left in the drawing below,



Two hinged stops and a sliding fence are shown in use below. At left, the nearer stop to the work acts as a gauge and the other is back out of the way while a short tenon is being cut. A long tenon is being cut at right with the farther block in use and the other one thrown back. The fence holds the work upright



That Save Workshop Time

while a pair are shown in use in the two photos. Slot the bar that is clamped flat on the table by boring end holes and ripping out the waste on the jigsaw. Make the tenon of the clamp a sliding fit for the slot. The clamp itself is made in two pieces, as shown, and can be attached readily to the edge of a drill-press, jigsaw, or bandsaw table by pulling the two blocks together with a bolt and wing nut.

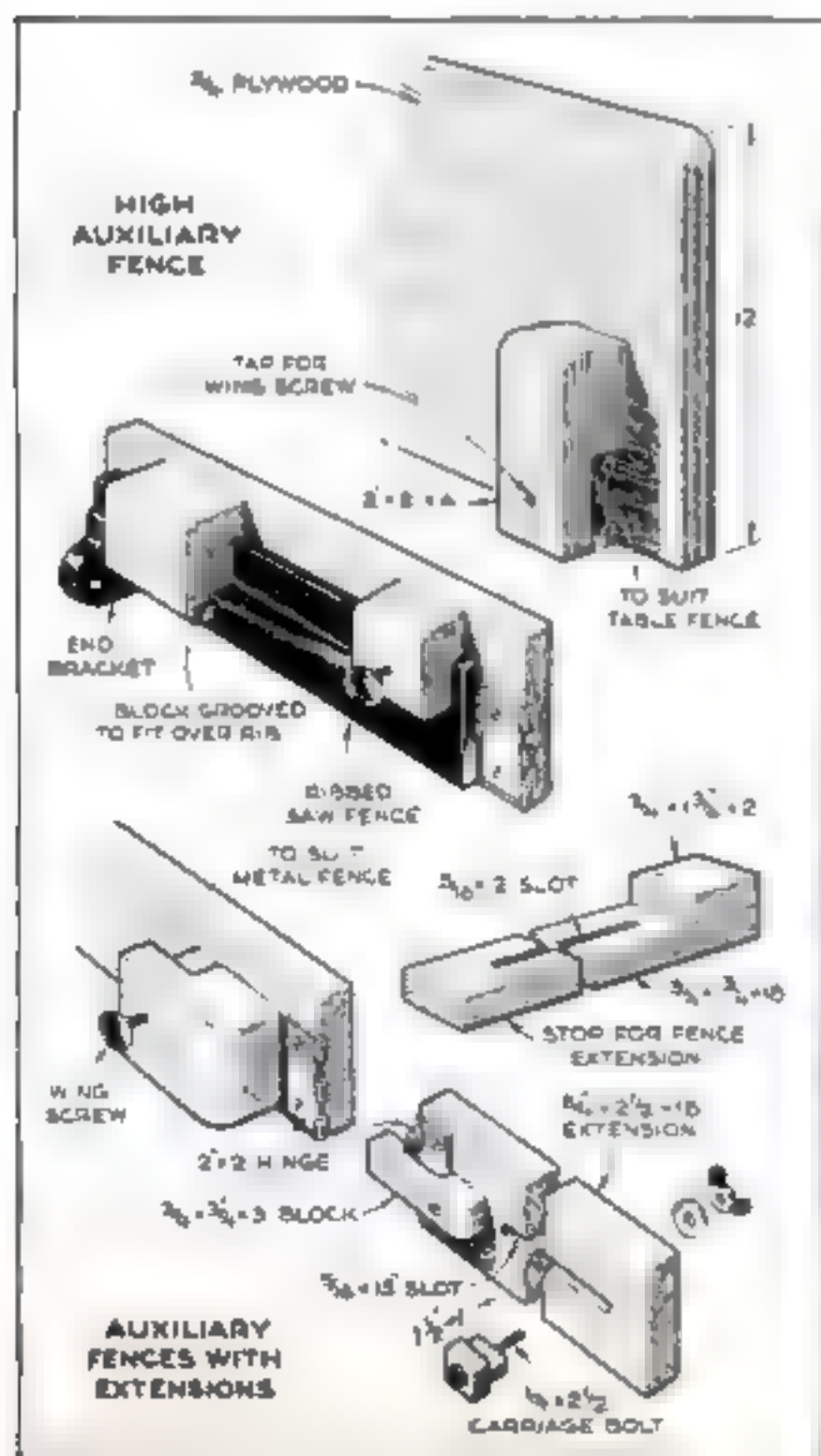
In one of the photos the hinged block at the end of the stop nearer the work is down on the table and the other is raised out of the way while a short tenon is being ripped on one end of the rail. The other photo shows the farther hinged block down while a long tenon is being cut on the other end of the rail. This is a typical setup that permits both ends of one rail to be finished before going to the next. In a large shop where a run of such pieces is to be made, a single stop is usually set for one tenon and reset for the other only after the first tenon has been cut on all pieces. Most small shops, however, do not have space between machines for piling up partly finished work,

and in them the hinged stops will be found particularly advantageous.

Of what value is the sliding fence? This attachment, also shown in the photos with the hinged stops as well as in a drawing, is clamped to the work to hold it accurately vertical while it is fed freehand against the saw. As used in the operations shown, such a fence enables the woodworker to rip both cheeks of a tenon simply by sliding the work lengthwise to suit.

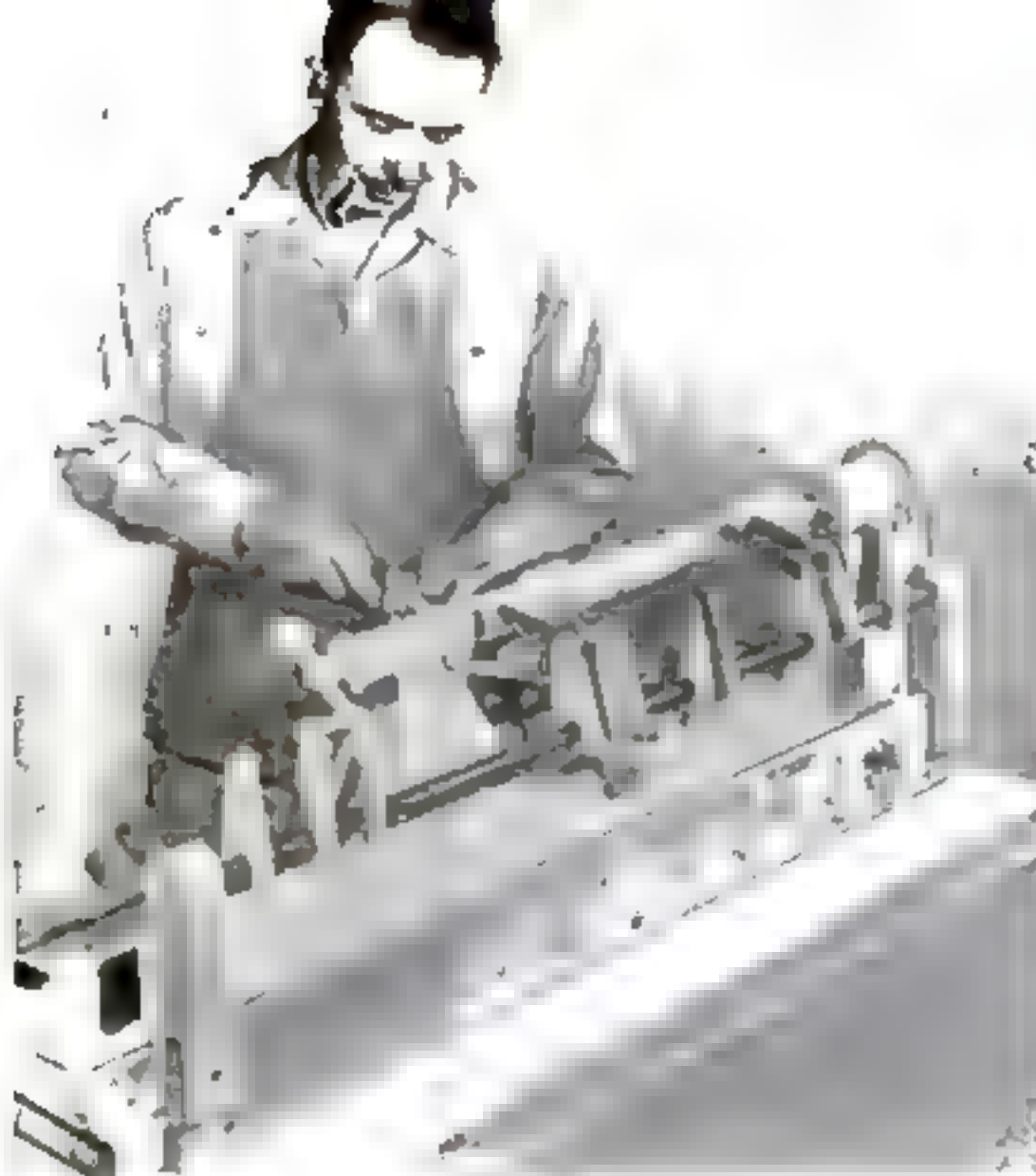
What is the pivot fence? It is a slotted bar with an upright fin. A clamp like that for the hinged stop is used to attach it to the saw table after the fin has been set at the required distance from the side of the bandsaw or jigsaw blade and lined up with the teeth as indicated in the drawing. The fence is useful in resawing and similar work. It regulates the thickness of the piece cut and yet allows it to swing to overcome lead in the blade.

How is the drill-press fence clamped? This is done simply by grinding off the sides of the regular clamping wing nut so it will clear the slots in the drill-press table and



Long pieces are sawed accurately with the help of a fence extension attached to an auxiliary fence with a loose-pin hinge. An adjustable stop in use on the extension is shown in the foreground below





Sizing cuts in turning a spindle are gauged by the lathe semaphore jig which has its flags adjusted to drop when the correct diameter is reached. At right, the spindle is supported by the steady rest as its end is bored. Note that the semaphores remain in place but are out of the way of the steady rest

by providing the fence with a washer bar, as shown in a drawing and photograph. With this arrangement it will not be necessary to take the wing nuts off completely every time the fence is put on the table or removed. The washer bar is made of wood and is reinforced with open washers bradded to the bottom of the slots to provide bearing surface for the wing nuts. It is slipped between the underside of the table and the nuts, and the nuts are turned up tight against it to lock the fence in place.

What does the circular saw require? Some manufacturers furnish saw fences that are arched for use with molding heads. Short, thin stock cannot be safely guided against such fences for ripping as the wood jams in the arch. A low auxiliary fence is therefore required to present a continuous surface for such ripping.

Two such fences are illustrated in the drawings, one for use with a flat ripping fence and the other for a fence having a ribbed back. The auxiliary fence for the former is equipped with notched blocks near the ends for fitting over the ends of the regular fence, while the blocks on the latter are attached at the top and are shaped to fit the ribs. Both fences are locked in place by wing screws turned into undersize holes bored in the blocks.

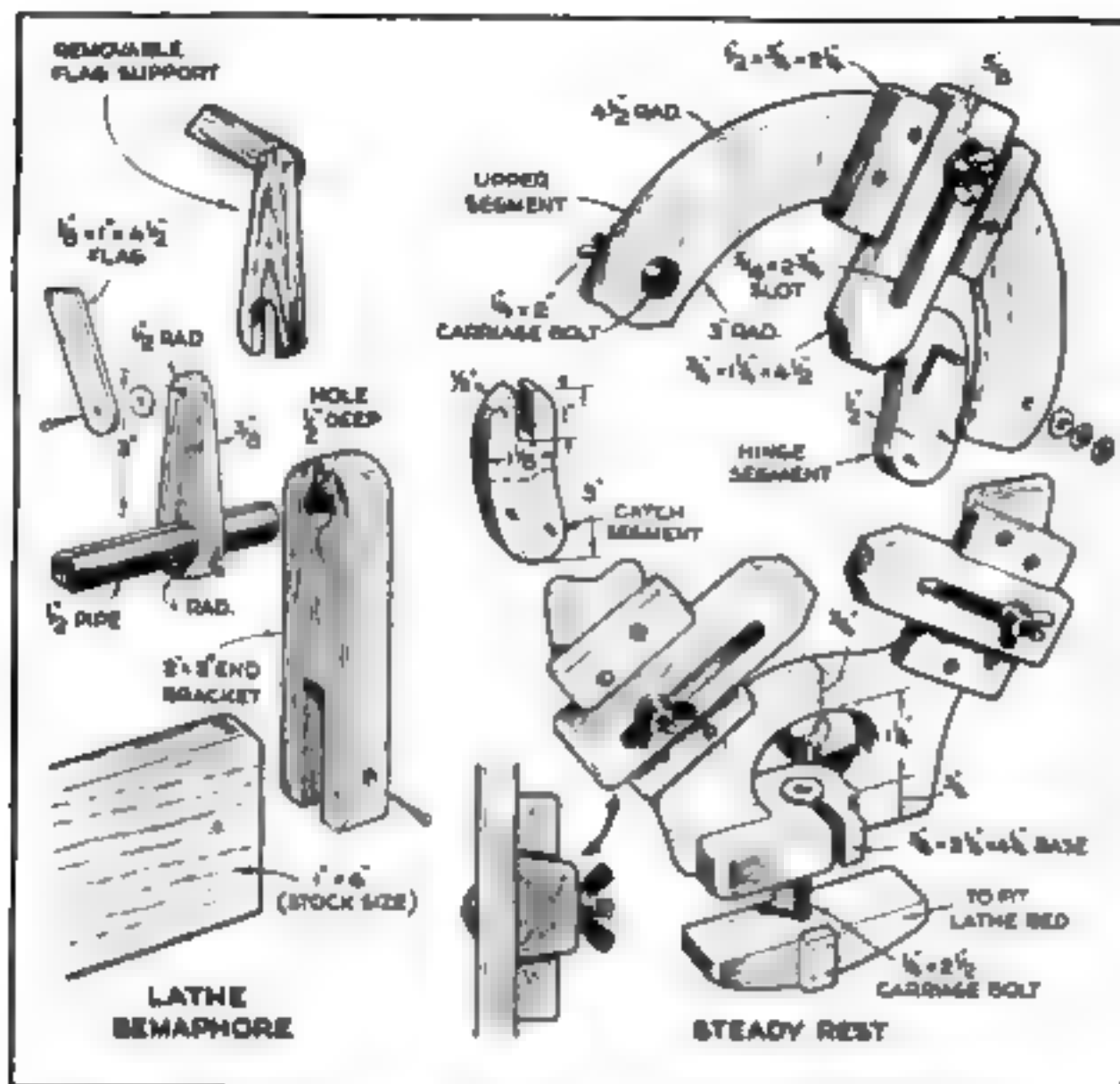
Should you have a circular saw that does not have an arched molding fence, an arched auxiliary fence can be built with attachment

blocks like those on the low auxiliary fence. Make it as thick as necessary for use with a molding head.

An extension for the low fence is attached with a loose-pin hinge, as shown in the drawing. It is held rigidly straight by a block screwed over its hinge leaf and extending over the leaf on the clamped auxiliary fence. Insertion or removal of the hinge pin is all that is necessary to attach or take off the extension piece. Slot the extension as shown to take a T-bolt that clamps an adjustable slotted stop in place anywhere along the length. Such an extension fence is shown in use in one of the photos. It permits sawing long stock.

In making a high auxiliary fence, attach the clamping blocks in a vertical position, as indicated in the drawing. Plywood is best for such a fence since a solid board wide enough to fill the requirements would be subject to warping.

How is a lathe semaphore built? In this variation of a familiar lathe accessory, the flags are pivoted on swiveling arms attached to a pipe that is held in place by end supports. This type of mounting prevents interference with the tool-rest supports and permits adjustment of the flags in and out to conform to a drawing, template, or turning. The flags are made of either hardwood or metal. They rest on the roughed turning until sizing cuts reduce the diameter enough to allow them to drop. In this way, they



What is done in making a steady rest? Cut the body from $\frac{1}{4}$ " plywood or well-seasoned hardwood to the shape indicated in the drawing, and saw the two segments apart. Hinge the upper segment with a bolt to a kidney-shaped link and latch it with a bolt that enters a slot in the upper end of a similar link. Both the hinge and latch are screwed rigidly to the lower segment.

Make three slotted guides as shown, bolt them in place, and screw block guides against them. The base clamp must be shaped to slide under the bed of the lathe, and it should have lugs to enter the slot and keep it from swiveling.

Use the rest near the center of long, slender turnings in order to stiffen them, or support the end of a spindle in the rest for

indicating that the correct diameter has been reached.

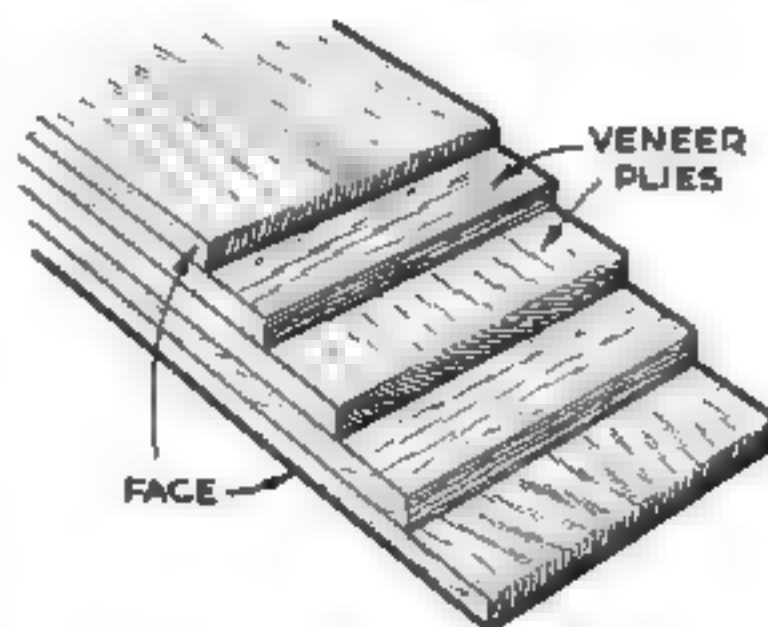
Since the flags tend to jump and may be thrown back by roughness of the turning, one hand can be held above while the sizing cut is being taken. No pressure should be put on the flags, however.

Several supports may be mounted permanently on the bar, and a few additional ones can be made with slotted ends, as shown. These can be attached quickly when extra flags are required for a job.

boring or turning. When the rest is used as a stiffener, it can be placed after rough turning by setting the guides into a wide sizing cut near the center, or it can be set up after the turning is almost completed. Any scorch mark made by it can be removed with light cuts and a little sanding. For end turning, the guides should bear against the tailstock side of a shoulder or bead so as to prevent the work from slipping off the spurs of the live center, as would otherwise happen.

PLYWOOD GRADING TERMS

[WOODWORKING]



Plywood is manufactured in two types, moisture resistant (M. Res.) and exterior (Ext.). Moisture resistant plywood is bonded with such glues as soybean adhesive and is suitable for use in dry places or where it will be subjected to no more than a slight wetting from condensation or small leaks. Exterior plywood is bonded with waterproof plastic glue, which is resistant to both cold and boiling water and to oil, alkalis and most acids. This plywood is suitable for outdoor construction, boats, and the like.

Both types of plywood are graded according to face veneers as follows:

Good. Single, smooth sheets, practically clear all heart veneer. Suitable for natural or stained finishes that reveal the grain.

Sound. One or more lengthwise sheets accurately joined, closely matched for grain, and free from knots, splits, checks, pitch pockets and other open defects. Streaks, discolorations, sapwood, shims, and nail patches are allowed. Surface smooth enough for painting.

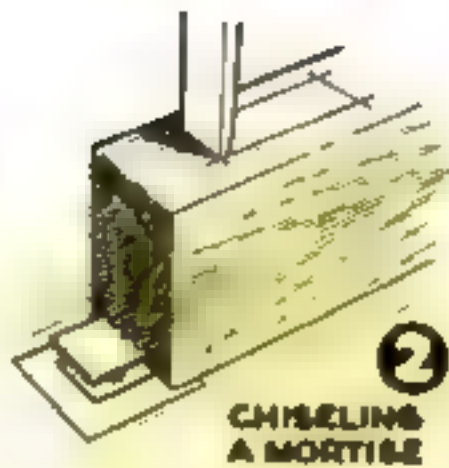
Utility. Single or pieced sheets, which may have knots, pitch pockets, and splits up to $\frac{1}{16}$ " wide that do not reduce the serviceability of the panel.

What's Wrong?



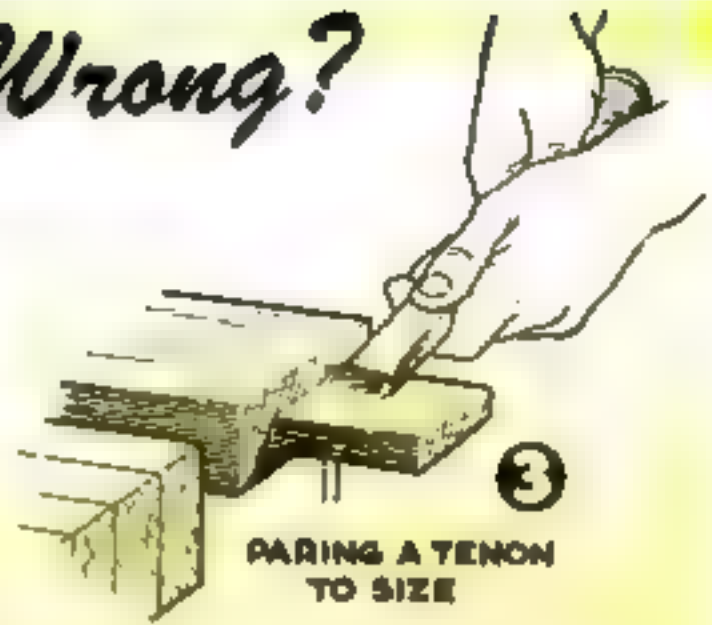
MORTISING FOR A BUTT HINGE

1



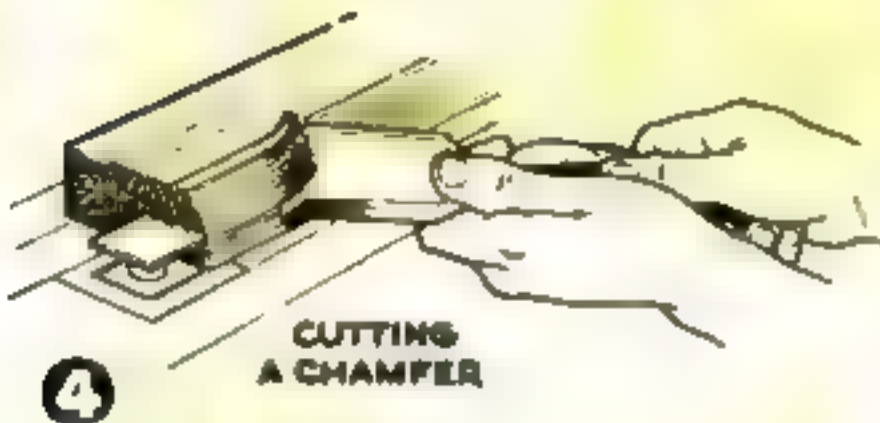
CHISELING A MORTISE

2



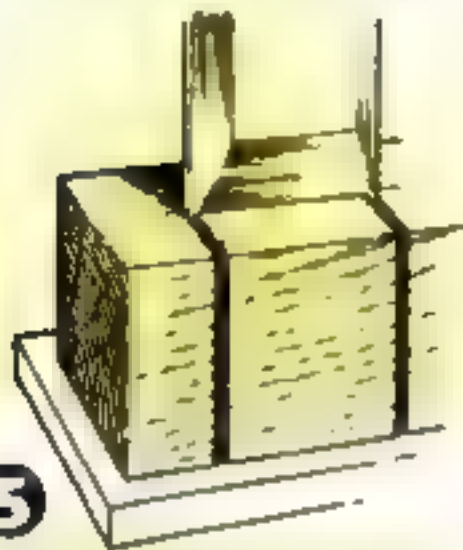
PARING A TENON TO SIZE

3



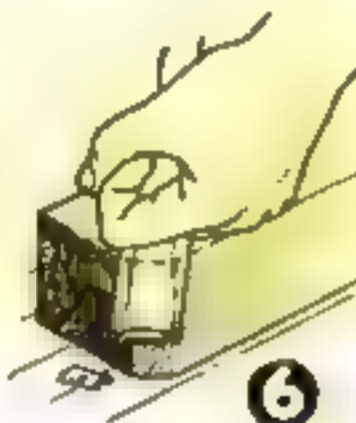
CUTTING A CHAMFER

4



CHISELING OUT A DADO

5



CHAMFERING A CORNER

6

THERE'S more to using a chisel than smacking it on the head. Seven errors are shown in the six illustrations, two of them in Fig. 4. Can you find them?

1. After scoring the back of the mortise, make full-width, full-depth chisel cuts across the grain from $\frac{1}{8}$ " to $\frac{1}{4}$ " apart to break the waste into small chips and prevent splintering into the bottom.
2. Cutting should be started near the center and the ends trimmed last to avoid crushing beyond the gauge lines.
3. If tenon cheeks are properly sawed to size, no chisel is needed. The procedure shown will leave a rough shoulder and prevent a clean, close fit.
4. The bench stop endangers the edge of the chisel. Besides, this is a finishing cut, and a plane should be used.
5. First bevel the waste at both sides of the dado and on both sides of the stock; then pare the piece out parallel to the bottom. Then pare the dado to depth.
6. There should be a scrap board under the work to avoid damaging the bench.

ANSWERS

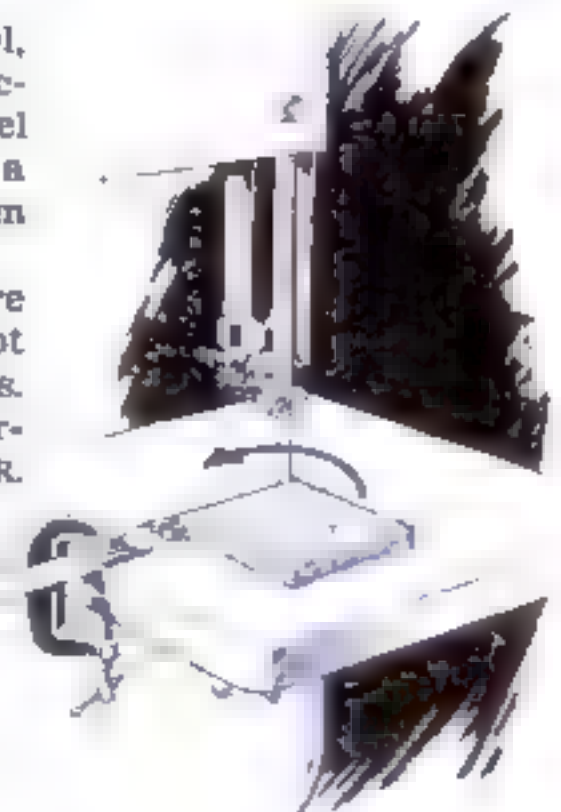
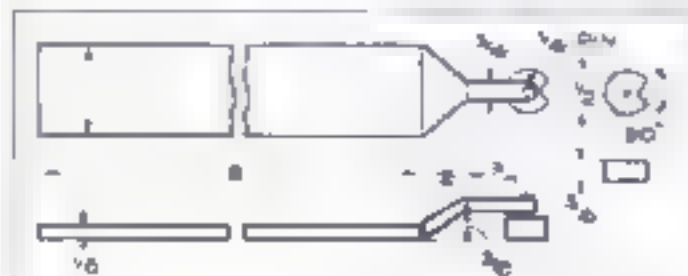
Notched Jig Accurately Gauges Round Edge of Corner Shelves

CIRCULAR edges of corner shelves and other sectors can be cut easily on a bandsaw or jig-saw with the aid of a jig like that shown in the drawing. Simply square two adjoining edges of the stock, fit the corner in the notch, and rotate the stock and the wheel 90 deg. on the saw table.

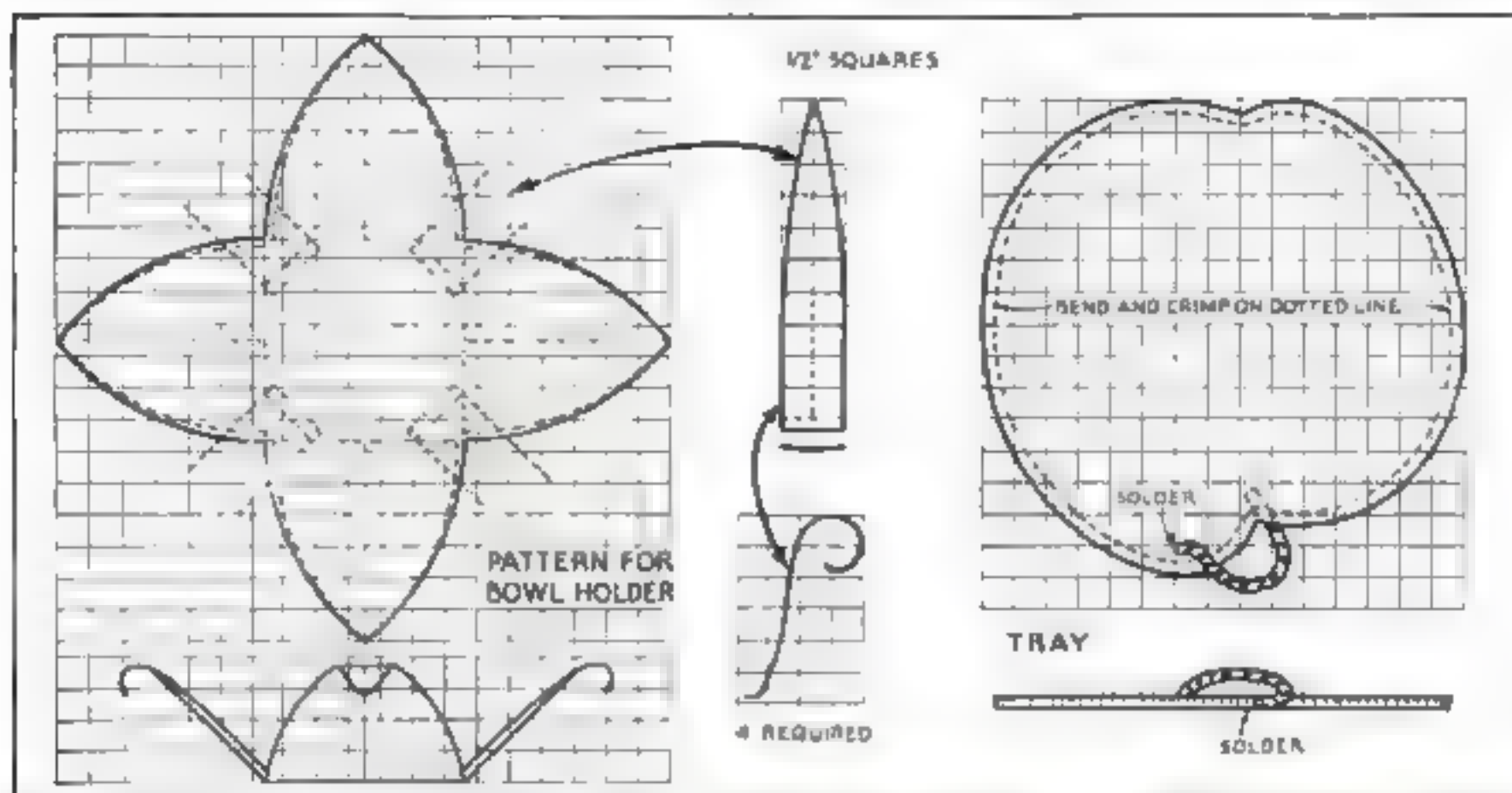
The jig is made from $\frac{1}{8}$ " by 1" by 6 $\frac{1}{2}$ " cold-rolled steel, cut to shape at one end with a hacksaw and bent as indicated in the drawing. File all edges and corners smooth. Make the wheel

from $\frac{1}{2}$ " drill rod or flat steel, cutting the 90-deg. notch accurately. Drill both the wheel and the shank of the jig for a pivot pin and counterbore them for riveting the pin in place.

In clamping the jig, measure from the saw blade to the pivot to set it for the desired radius. To correct lead, set the jig forward or back. W. B. WEBER.



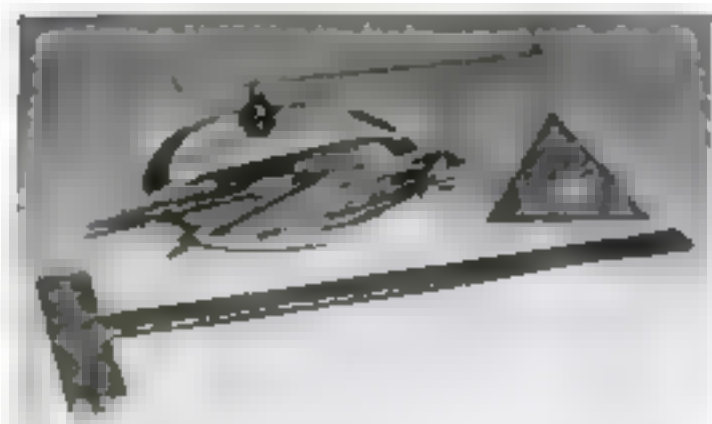
Smart Tin-Plate Accessories Set Off Candy or Flower Bowl



TIN cans useless for salvage afford material for this attractive gift ensemble. Designed to hold short-stemmed flowers, it serves equally well as a candy or nut dish.

On a sheet of tin plate paste a paper pattern of the bowl holder traced on $\frac{1}{2}$ " squares from the drawing above. Bend the piece as shown, shape four "petals," and solder them to it.

The edge of the tray is bent up and crimped with round-nose pliers. For the loop, cut a $\frac{1}{4}$ " wide strip and wind it spirally around a curved piece of coat-hanger wire. Solder both ends to the underside of the tray. Burnish with fine steel wool and coat all parts with clear lacquer.—CARL BIXTSCU.



Paper Plates Secure Ink Bottle

A SAFE holder for a bottle of India ink is quickly made of two paper plates. Cut one in half, discard one piece, and near the cut edge of the other make a hole about $\frac{3}{8}$ " in diameter. Staple this piece to a second plate and force the neck of the bottle through the hole. The lower plate serves as a tray to hold your drawing instruments.—A. D. SLATER.



Lapel Ornament from Fountain-Pen Cap

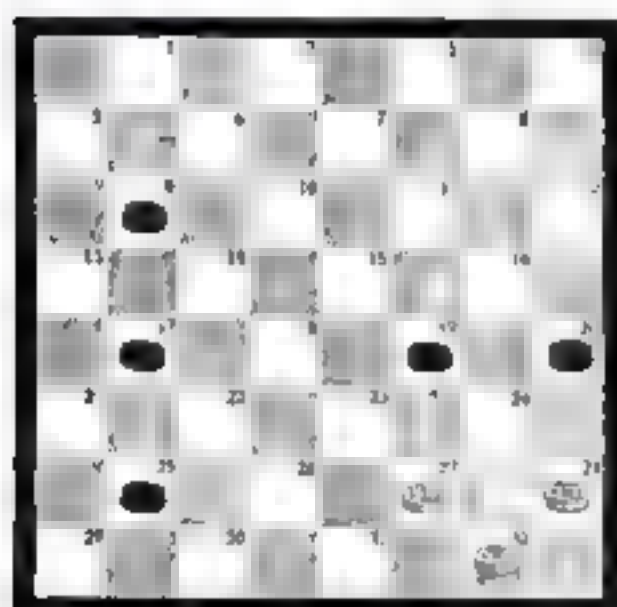
WHEN a fountain pen is beyond repair, the cap can be put to use as an unusual lapel vase, particularly if it is of some colorful material. Slide the clip of the cap through the buttonhole or, if there is no buttonhole, push a safety pin from the back of the lapel through the space under the clip. Insert a tiny flower or two.—B. N.

HOW ARE YOUR CHECKER WITS?



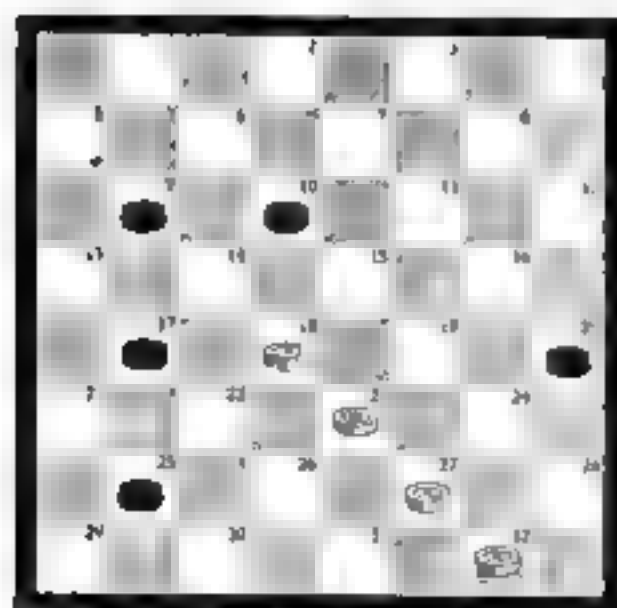
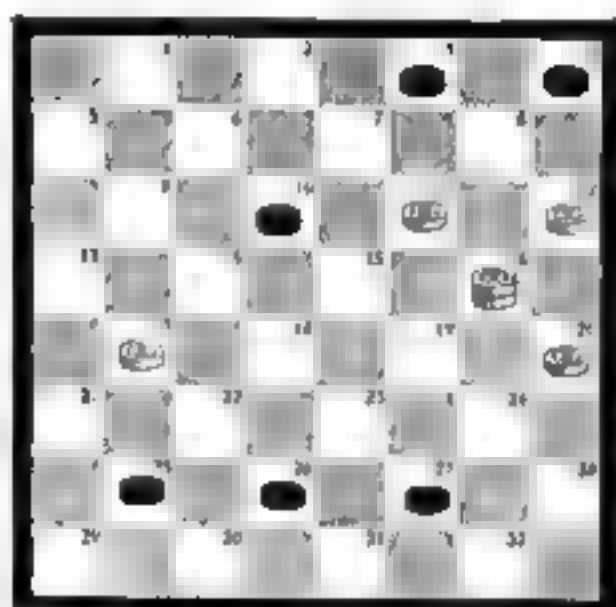
HERE are some puzzlers in checkers that may make the impetuous player get himself into a trap or, at best, a draw. They are favorites of Millard Hopper, the checker king, who furnishes some really tricky solutions that are given below. Before you read his answers alongside the boards, try to solve the games yourself—but look beyond what may appear at first to be obvious.

In each instance White has fewer men than Black but has the advantage of first move. If this move is made correctly, then White will win. For clarity in printing, the men are shown on white squares, although in play they move on the black. White moves toward the top of the board.



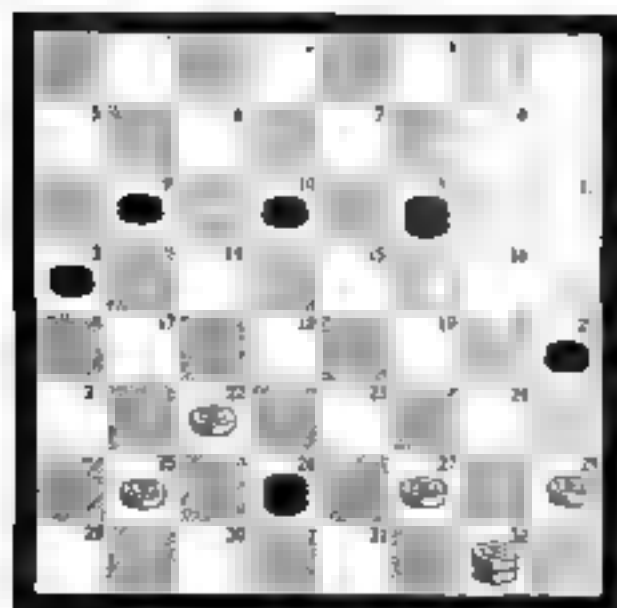
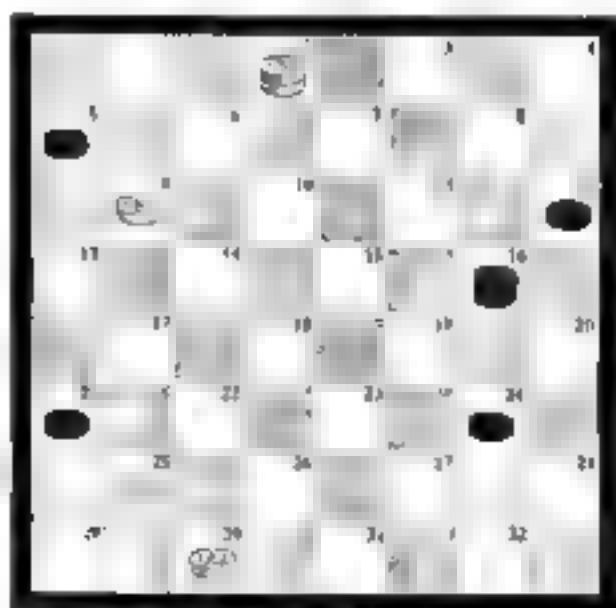
WOULD YOU START with that 27-24 "two-for-one"? Don't do it; you'd only lose. Play 27-23, 19-26, 28-24, 20-27, then that big 32-5 to win.

STAY AWAY from the temptation of 11-8. You can force things your way by trying 17-14, 10-17, 11-7, 3-10, 12-8, and 4-11, to win by 16-32.



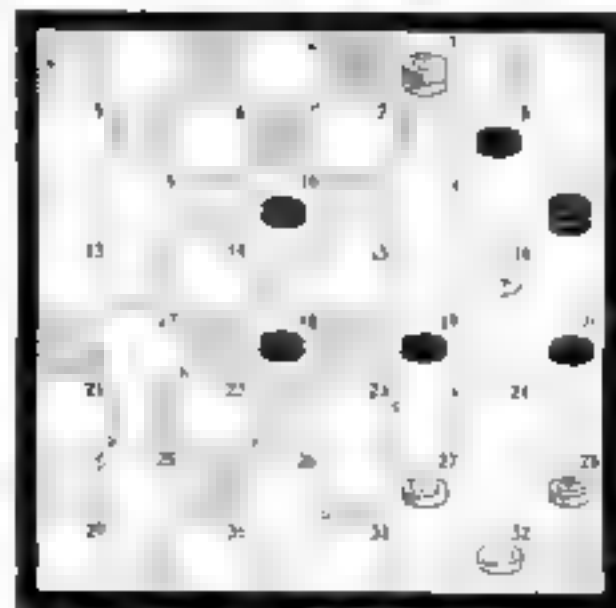
AN, AH! DON'T! You'd only get a gold brick with 18-14. There's a better buy at 18-15, 10-26, 27-24, 20-27, and a 32-5 sweep.

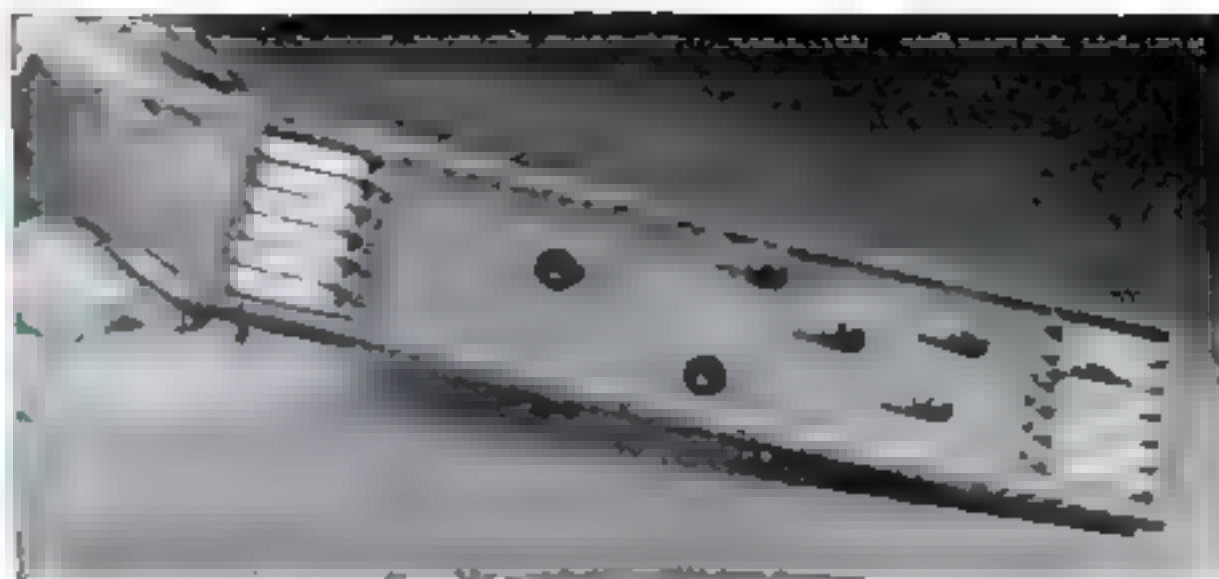
AVOID SAVING the man on 9. It sets the trap. Move 2-8, Black jumps 5-14, and then move 30-26, 21-30, 6-9, 30-23, 9-11, and Black resigns.



25-21 LOOKS GOOD, but it's only a draw. If you play 28-24, 26-17, 27-23, 20-27, 25-22, 17-19, and 32-5, Black's game will be hopeless.

DON'T FALL FOR 27-24, 20-27, 32-7 or Black may win. Instead, play 28-24, 19-28, 3-7, 12-19, 7-16, 8-12, and 16-19.





KEEP 'EM ROLLING FOR A HIGH SCORE Action Checker Game Is Real Skill Tester

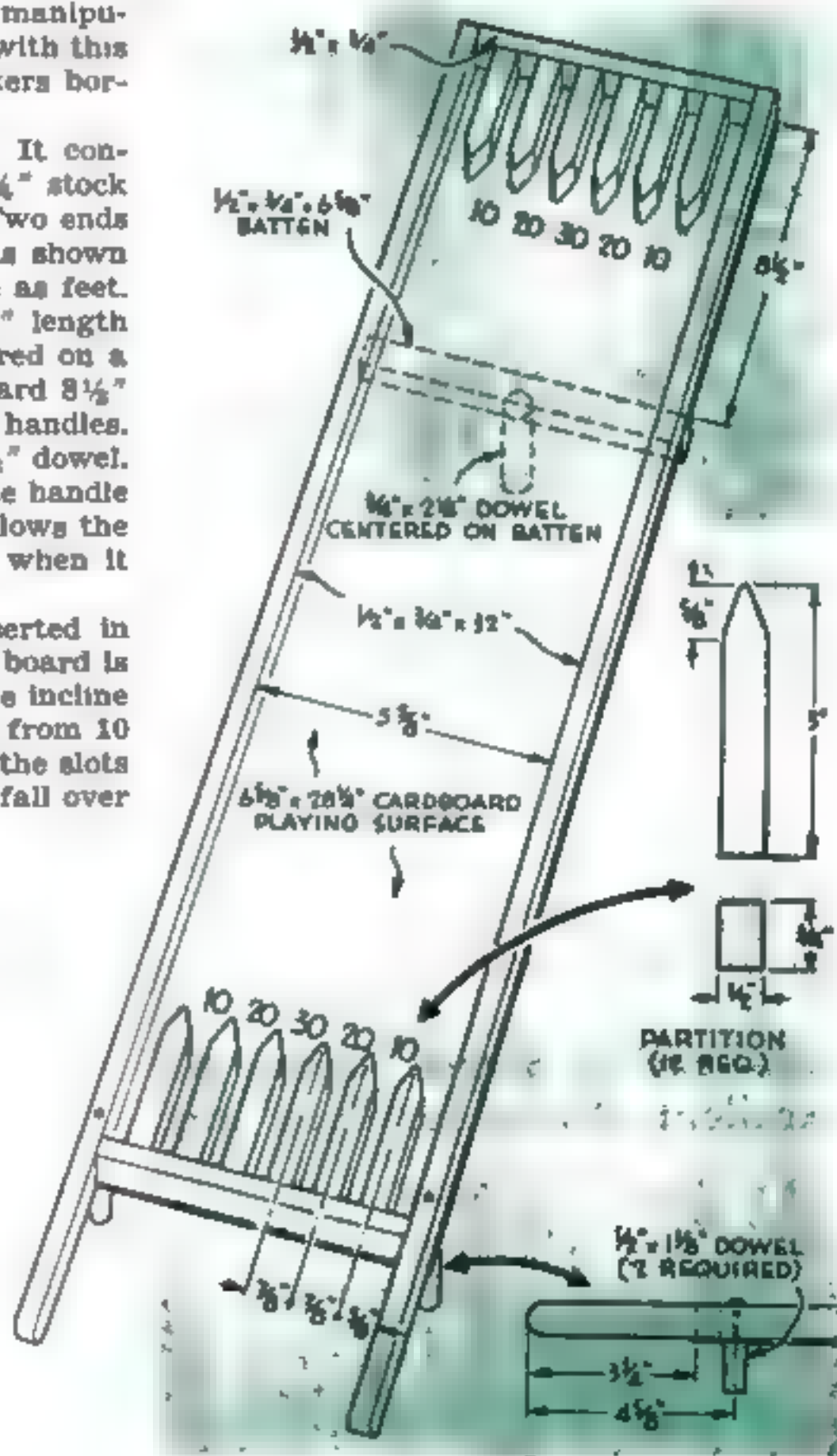
By MYRON FLEISHMAN

HIGH scoring and some exciting manipulation of the board are possible with this new game played with seven checkers borrowed from your regular set.

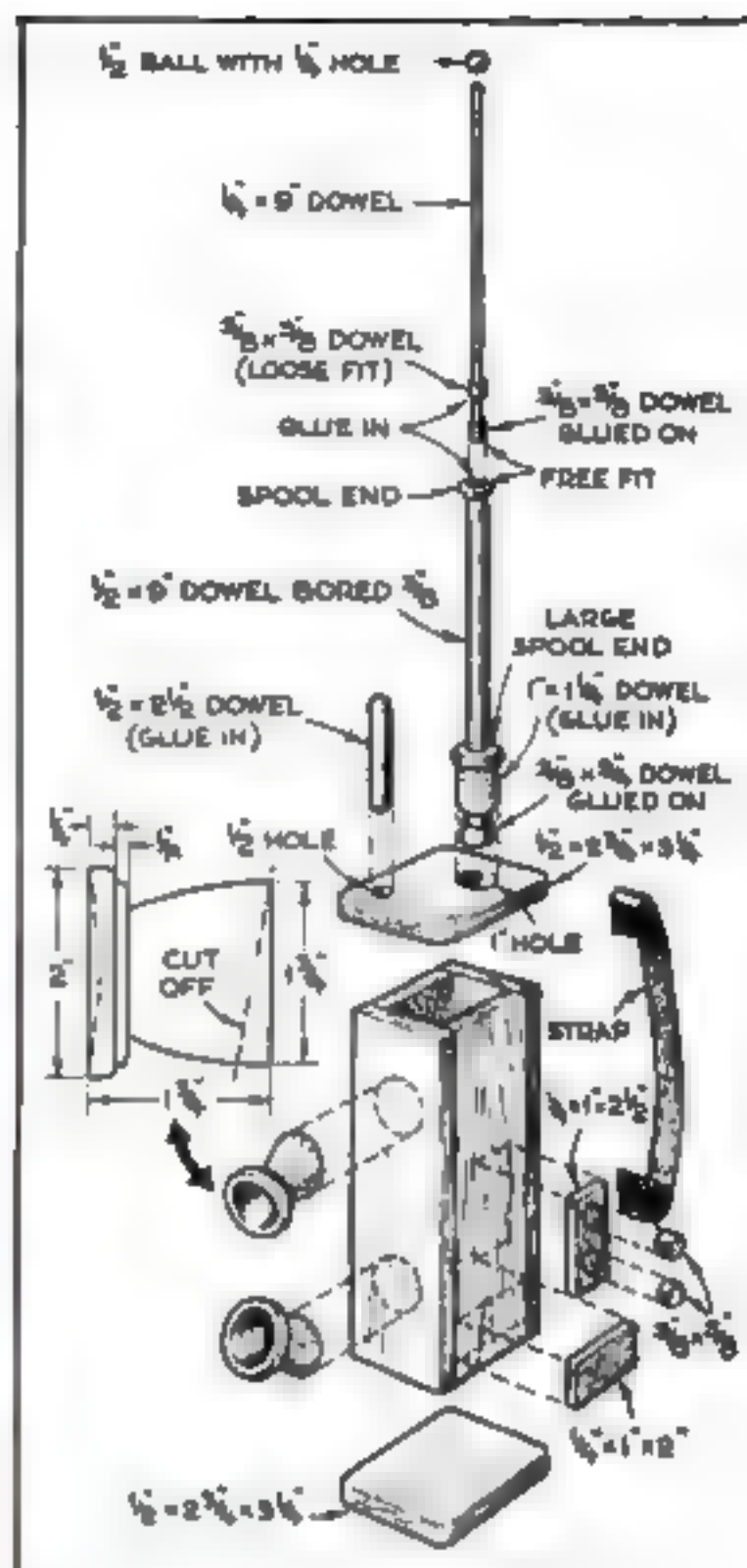
The board itself is easily made. It consists simply of a frame of $\frac{1}{2}$ " by $\frac{3}{4}$ " stock around a sheet of stiff cardboard. Two ends of the frame extend for handles, as shown in the drawing. Three dowels serve as feet. One of these, as indicated, is a $2\frac{1}{4}$ " length of $\frac{3}{4}$ " diameter dowel and is centered on a batten across the bottom of the board $8\frac{1}{2}$ " from the end that does not have handles. The other two are $1\frac{1}{2}$ " lengths of $\frac{1}{2}$ " dowel. They are placed in the corners at the handle end, as shown. This arrangement allows the board to slant toward the handles when it rests on a table.

To play, seven checkers are inserted in the slots at the handle end, and the board is raised so that they will roll down the incline to the other end. The player scores from 10 to 30 according to the markings on the slots into which the checkers roll. If any fall over during the process they are removed from the board. Those that enter the unnumbered outside slots do not score, but they are not removed.

The board is next permitted to tilt back again, and the checkers are allowed to roll back to the starting end. Scores are again counted and added to those made in the first play. Checkers that fall over are again removed. The board is then raised by the handles and tilted to roll the checkers a third time, and the operations are repeated until there are no checkers remaining to be rolled. Each player has three turns, and high score wins.



TOY WALKIE-TALKIE THRILLS YOUNG COMMANDOS



THAT young "commando" in your home will be the envy of the neighborhood when he goes out to play war with a toy walkie-talkie like that shown above. For all its G.I. look, the toy is built of scrap stock and a length of webbing or a belt.

The rectangular case is a $2\frac{1}{2}$ " by 3" by 10" closed box, with rounded top and bottom pieces overhanging the sides $\frac{1}{4}$ " all around. Make the body of two $\frac{1}{2}$ " by 2" by 9" pieces and two that are $\frac{1}{2}$ " by $2\frac{1}{2}$ " by 9", gluing and nailing the simple butt joints for

strength. The mouth and ear pieces shown are turned in a lathe and then sawed off on a diagonal, as shown in the drawing, but if you are good at whittling there is no reason why you can't shape them by hand. Two dowels form dummy controls on one side.

How the telescoping antenna is put together is shown in the drawing. Drilling the $\frac{1}{8}$ " diameter dowel takes great care, and it is best to drill from both ends.

Finish with khaki paint and trim with white as in the photo.—FRANK MCCARTY.

Ball-Bearing Swivel Caster Makes Excellent Mount for Punching Bag

IF YOU have trouble finding a standard swivel for suspending a punching bag, use a plate-type ball-bearing swivel caster for the overhead mount. It can be readily held on by screws. The caster works on very nearly the same principle as the regulation swivel.—K. M. MARTIN.



Tricky Keyless Latch Opens Only to Secret Combination

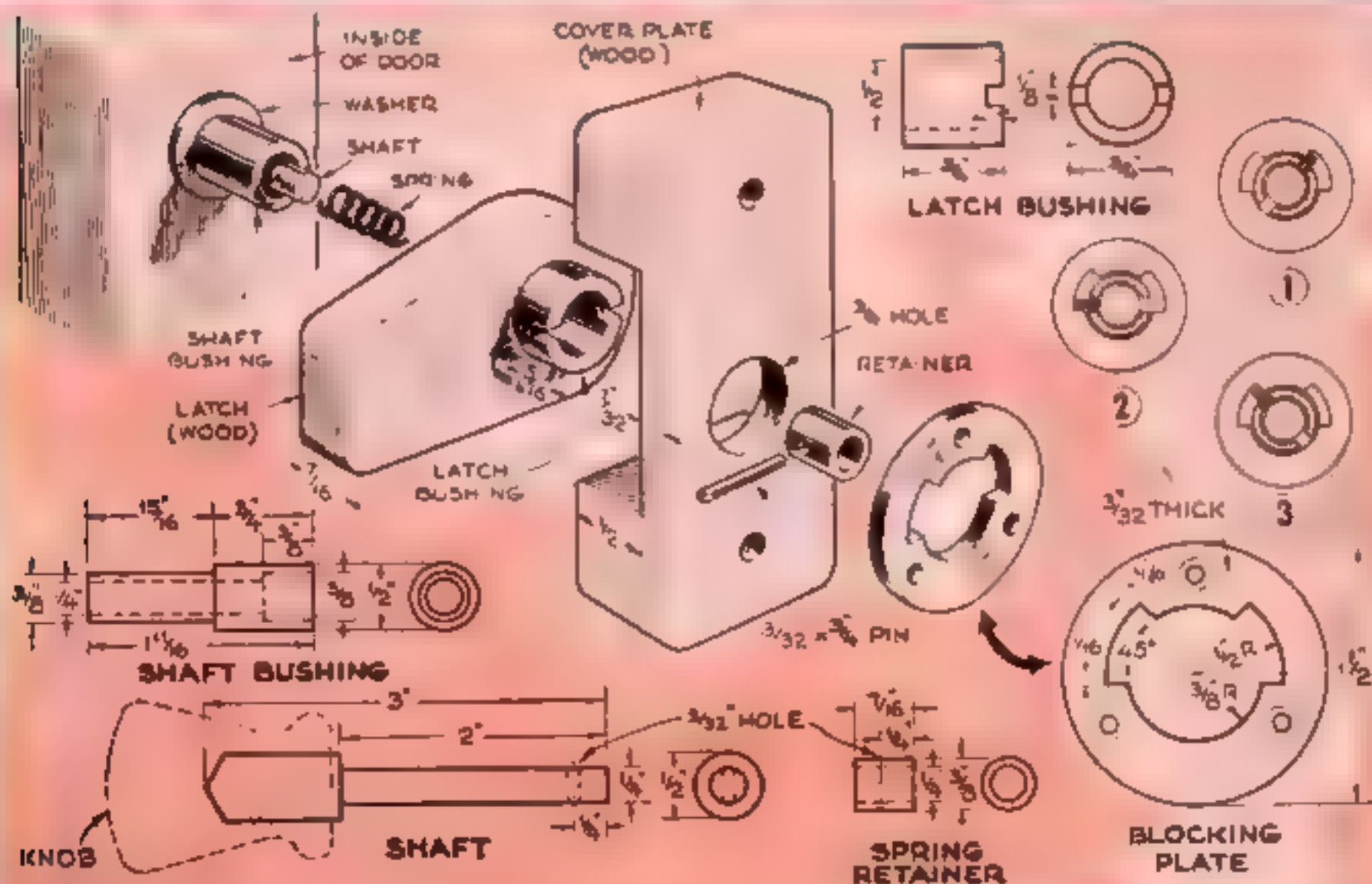


A wooden cover keeps the latch in place; the latch bushing should extend $\frac{3}{32}$ " past it. Insert the shaft from the front of the door, slip on a suitable spring, and fasten the retainer with a $\frac{3}{32}$ " pin, which protrudes $\frac{5}{16}$ ".

File the blocking plate from a big washer, checking it against a drawn pattern. Screw it to the cover plate as in the drawings (Figs. 1, 2, and 3). In Fig. 1 the latch is closed; the knob can be pulled out and given a partial turn clockwise (as seen from inside the door). It is then pushed in and given half a turn to the position in Fig. 2. When it is again pulled out and turned further as in Fig. 3, the latch is open. The positions shown are for a door hinged on the left.—JOHN M. AVERY.

AN INTRIGUING addition to a cabinet or desk is a door that can be opened only by those in on the secret. A certain combination of twists is required to throw the latch shown, tricky enough to puzzle the uninitiated.

Turn the shaft and bushings from steel or brass, make the latch to suit the door, and drive the latch bushing into an undersize hole in the latch. Press the shaft bushing into the door frame from inside; then slip a washer over the protruding portion.





WATCH THE SURPRISE on your friends' faces as you get the laugh on them with this napkin-tumbler trick. Ask one to extend his arms, grasp a covered tumbler in each hand, and lift them quickly over his head. One tumbler will fly up; the other will prove unexpectedly heavy—for that one you will have filled beforehand with lead shot, iron nuts, screws, or nails to add weight and catch your victim un-awares! The napkin hides them

TABLE TRICKS



CAPILLARY ATTRACTION between water and ordinary string will help you to empty one glass mysteriously into another. Twist several feet of string into a skeinlike length, put one end in the glass of water, and let the other end hang over the edge to a point below the bottom. Now hold the empty glass beneath it, and soon the string will begin to act as a wick, drawing water from the filled glass up over the edge and allowing it to drip down to the other one below.

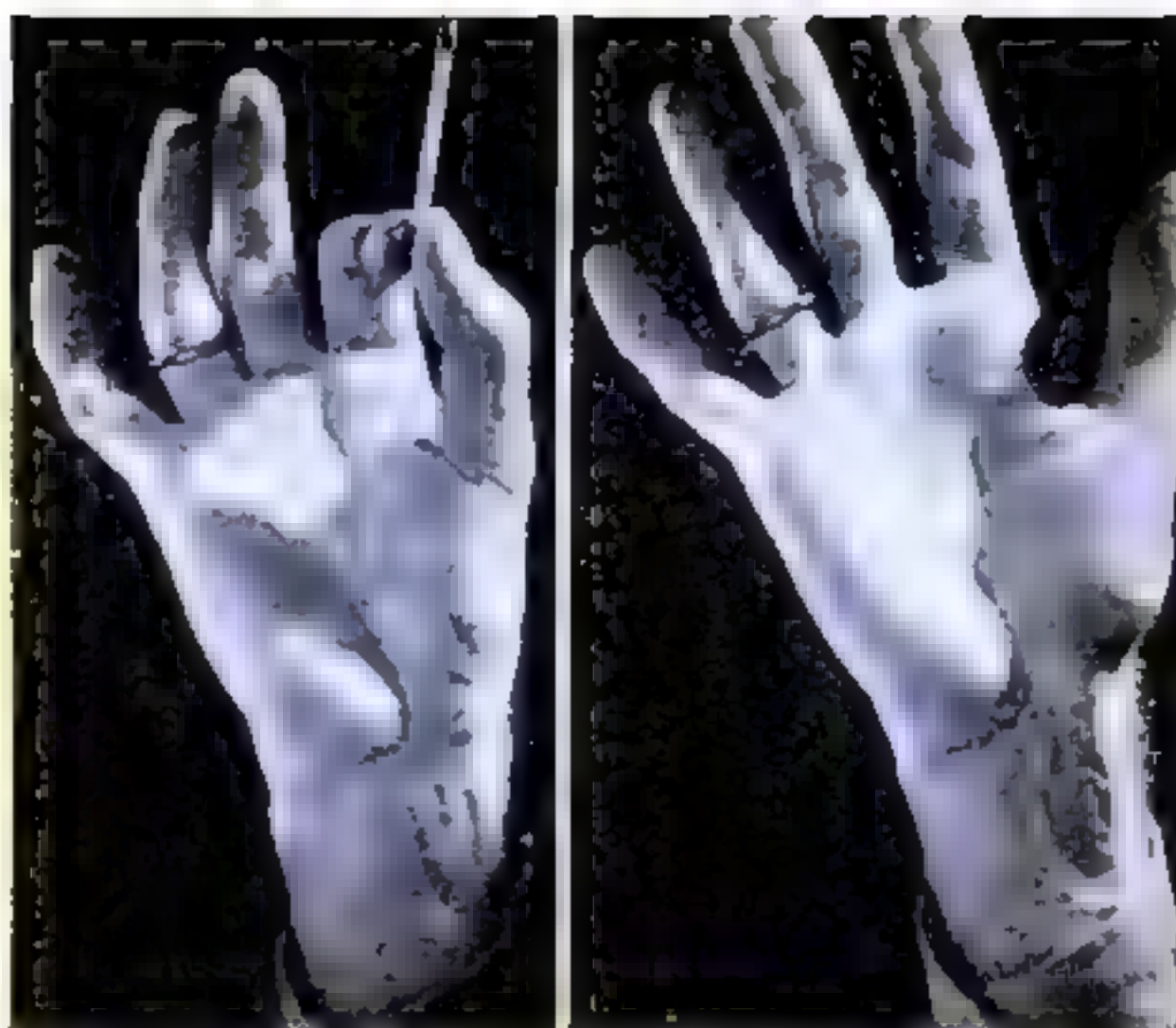


NOW YOU SEE IT, and now you don't! Place a coin or medal under a clear glass of water while no one is looking and challenge your friends to tell, without moving the glass, what is under it. Because of refraction of light rays, bent by the water so they cannot reach the eye of an onlooker through the sides of the glass, nothing can be seen under the tumbler. But if you now drink the water out through a straw, the coin will be plainly visible to all! Of course, the coin can also be seen all the time by anyone who looks down through the top of the tumbler, so arrange the glass on a table at a high enough level to keep from giving the trick away to an observant onlooker.

HERE'S ONE THAT SCIENCE can't explain nearly so simply as the practical observer with a quick eye. Rub your finger briskly on your woolen coat sleeve and make a little paper cylinder follow it obediently around the table. Your scientific friends will say that it is impossible to create electricity that way. And if they try, they will fail. So would you if you didn't know the trick. Rubbing your finger is just a gag. What you do is to blow gently on the table just behind the little cylinder in order to make it roll!



SLEIGHT OF HAND is always interesting in an after-dinner gathering. This trick is simple, but it requires some dexterity that can be attained with a little practice. You will need a loose ring on your fourth finger and an ordinary kitchen match. Hold the match between the thumb and forefinger and show it to the assembly. Then wave the hand rapidly for an instant, and, lo! the match will have disappeared. What happens, of course, is that you secrete the match in the ring behind the finger. This can be done easily by bending the middle finger out of the way into your palm as you wave.



BOTTLE-CAP VACUUMS are more of an illusion than a reality. Tell your friends that you can create a vacuum in a metal bottle cap by sucking the air out, and make a great pretense of doing so. Then to "prove" that you have a vacuum, place the cap on a handkerchief draped over the palm of one hand and lift it. The handkerchief will come up with it! This isn't because of a vacuum, though. Have the removed cork from the cap in your hand under the handkerchief, and press it into the cap to hold the cloth, as in the photo above.

FIRE FROM AN UNLIT MATCH, or from a plain scrap of paper, will startle your guests. Attract their attention so they will see that the match or paper isn't afire when you drop it into a tumbler; then place a saucer over the tumbler and soon clouds of white smoke will arise. Have a few drops of household ammonia in the bottom of the tumbler and surreptitiously rub a drop or two of muriatic acid on the bottom of the saucer! Vapors from the two liquids combine to form a dense white smoke. The match or scrap of paper is used merely as a bluff.



Controlled Light...

The Photographer's Paintbrush

By KONRAD CRAMER

EVER since the introduction of the modern tungsten-filament bulb, the amateur photographer has had at his command easily controlled illumination in quantities limited only by his pocketbook. Later, when the short-lived but brilliant photoflood lamp was marketed, he really got more light than he could properly handle. The average amateur, as a consequence, tends to use too much light with too little control. So these two factors—the control and the intensity of light—are worthy of particular attention on the part of the studious amateur.

To be able to control light, you should understand the simple fundamentals of light and shade. Otherwise you will do a lot of needless running back and forth, moving of your lamps vertically and horizontally, and checking by peeking frequently at your subject through your view finder before you finally arrive at the lighting effect that you are seeking. The top drawing on this page shows an apple on a plate. If you look closely, you will see a fly crawling on the surface of the apple. Imagine, if you will, that you are that little fly and that someone is squirting water at you. Where on the apple, the plate, or the table would you be safe from the steady stream of water? Obviously, the only secure places lie within the shaded areas. Now imagine that, instead of water, light rays are hitting the apple, the plate, and the table. The areas that are directly hit by these rays are bathed in light. The areas that are not directly hit—those that remain dry when water is played on the objects—are shadowed.

The human head is roughly the same shape as an apple. The only differences are that the head has a few hollows, such as the eyes and the mouth, and a few protuber-

ances, such as the ears and the nose. Below the picture of the apple are two sketches of a human face. The first one is filled in to show light and shade when the light source is at A. The second one is unshaded. Trace it three times on a piece of transparent paper; then, imagining the light source to be first at A, next at B, and finally at C, try shading the three sketches. If you can't conceive where a shadow should go, recall to mind the little fly. Wherever he would remain completely dry, draw in dark shadows. Wherever he would get a little moist, put in light shadows or, as they are called by artists, half shadows.

Now that you have learned the principles that, properly applied, will give you a cer-





Using natural daylight and but one spot—to high-light the model's hair—the photographer has caught here that elusive but highly desirable feeling of naturalness that distinguishes the true craftsman

tain amount of control over the directional quality of light, you should concern yourself with the amount or intensity of the light. Extremely strong light is essential only if your subject is in motion, and it is best supplied by flash bulbs. Although these may be used without shutter synchronization, a synchronized-flash shot is better because it insures a picture every time the shutter is released. Too many flash pictures are monotonous because the reflectors are

mounted too close to the camera, thus eliminating all possibility of varying the direction of the light. To overcome this, don't mount the flash on your camera, but make it independently movable. Excellent results can be achieved with batteries of flash bulbs if they are used judiciously.

For a little less intensity, a photoflood lamp is indicated, although it has two rather serious inherent disadvantages that should be carefully weighed against the obvious



idea to add a diffusing screen to the reflector because it will give a soft and flattering light. One made from spun glass is best, but one made from a square of crepe or Chinese will do if you mount it far enough away from the bulb so there is no danger of fire.

3. One of the readily obtainable mushroom-type bulbs. Although rated at only 150 watts, they have built-in reflectors that make them highly efficient. The

Both of these pictures were taken at too slow a shutter speed and underdeveloped if judged by usually accepted rules for good photography. This is especially true of the scene of the left

advantages. In the first place, the light given off, being rather harsh and raw, is hard on a model's eyes. So portraits that are made in such a light may be unsatisfactory because of the subjects' strained facial expressions. Second, the photo-flood bulb has a comparatively short life expectancy. Since you can't be sure that it won't go out at a crucial moment, this tendency to an untimely end doesn't contribute to your peace of mind. Then too, it makes photo-floods expensive to use.

If you are an average amateur and have only regular house-wiring facilities available, you should be able to make good pictures with the following lighting equipment:

1. One or two 500-watt PS-40 Mogul-base bulbs in 16" bowl-type reflectors. These are excellent for general lighting purposes. The efficiency of the reflector is of great importance. The collapsible paper type is one of the most popular and is highly recommended.

2. A 500-watt T-20 bulb in a sunray reflector. This should be used for secondary lighting in doing portrait work. It is a good



most convenient way to mount one is on a flexible cable that is fastened to a heavy base. This allows instant adjustment.

4. A small spotlight with an adjustable beam. Such a light is handy, but be sure not to buy one of the smallest sizes. The bulbs are short-lived because they are inadequately ventilated.

Studio lighting is composed of two elements—general illumination and effect lights. General illumination is that which fills the room where you are working. It should be nondirectional. The degree of intensity needed depends on the reflecting power of the walls of the room—you will need more light in a dark-walled room than in one with light walls. This factor must also be considered when using flashbulbs. Effect lights are those that are played on a subject to produce a certain result. Naturally, they should be of higher intensity than the general illumination. You will probably be more successful in the beginning if you use but one effect light. Add additional lights only as you gain experience.

After setting up your lighting, determine whether or not balance has been achieved by looking at the scene through a blue viewing filter or a few layers of blue cellophane sandwiched between two pieces of window glass. Such a device will show up any uneven lighting much more clearly than the naked eye can perceive it.

To make sure of a high percentage of correct exposures with a certain lighting setup, conduct the following experiment. Calculate



Two 500-watt bulbs—one placed near the camera for an effect light and the other used for background lighting—provided all the necessary illumination for this fine portrait study

Small mirrors were used as reflectors to light up the centers of the morning-glories in the photograph below



what you think is the correct exposure and take a picture at that exposure, then take one at an exposure that is five times as long and another at an exposure a fifth as long. Develop the films and select the negative that will give the best results on No. 1 or No. 2 paper. The exposure that produced this negative will then be your standard exposure for that particular lighting setup. However, it may not be sufficient to bracket an exposure in this manner if the parts of a scene vary greatly in brightness. Then it becomes necessary to relate the exposure correctly to the development that the film receives. This balancing of exposure and development is the only means by which such contrasting material as that shown in the barn-lantern picture on page 178 can be brought under control.

Whenever you find that you must use too slow a shutter speed, increase the intensity of your illumination. A good standard exposure for portrait work is $\frac{1}{4}$ sec. at $f/6.3$. If you use film



THE only light used in this photo was that from the lantern. A reflector was placed to the right of the subject. The flame gave a light-meter reading of 100 while the rest of the subject didn't budge the meter at all. This indicated that the brightness range was too great; so the flame was reduced to give a reading that indicated an exposure of 8 sec. at $f/32$. Such an exposure would have been correct for white light, but the flame was orange; so a 6-min. exposure (a tremendous overexposure) was used. The film was developed for $4\frac{1}{2}$ min. at 70 deg. to 0.5 gamma. The print, on No. 2 paper, was developed for 6 min. at 70 deg. in an amidol developer with 45 c.c. of a 10-percent solution of potassium bromide.

that is larger in size than $2\frac{1}{4}$ " by $3\frac{1}{4}$ ", it's not a bad idea to economize by making a mask to permit shooting two exposures on one sheet.

The barn-lantern picture that was just mentioned was taken as an experiment to find out how little light will suffice for good photographic work. The result seems to prove that it isn't necessary to bring a powerhouse into your home to photograph still life.

Each of the other pictures that are reproduced on these pages presented a distinct

lighting problem for the photographer to solve. The winsome little "mother" on page 175 was posed in natural daylight. This alone, however, left her hair looking dull and lifeless; so a spot was used to high-light her tresses.

On page 176, the photo of the woman reading is an excellent example of balanced lighting. The general lighting was in the form of daylight from a window at the left. For an effect light, a 60-watt bulb was used in the tabletop lamp. The window shades were drawn until the lamplight effect was clearly visible in a blue viewing filter. This was necessary since the object was to get a picture of a scene that was flooded by the light of the lamp. If the general lighting had been stronger, the lamp would not have looked like a source of light. The film was overexposed—1 sec. at $f/8.3$ —and underdeveloped—0.5 gamma. A straight print was made on No. 1 black paper, developed in amidol with a 10-percent bromide solution.

The coy sophisticate, also on page 176, was shot with natural daylight as general lighting, to which was added a spot for high light. The next picture, on page 177, was lighted by two 500-watt bulbs. One was placed near the camera and the other was used for general background lighting. The photo below it—that showing the morning-glories in a vase on a burlap background—was illuminated entirely by arti-

ficial lighting. Small mirrors were used to reflect the light into the centers of the flowers.

Remember that the difference between a good picture and a poor one is largely a matter of how they are lighted. Keep your lighting simple—one general light and one effect light are all you really need at first—and keep it under control. Don't manipulate your lights purely by trial and error, for that will waste time; instead, visualize the little bug on the apple and anticipate the effect your lighting will produce.

CAN YOU BEAT THESE PICTURES?

We will pay \$5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.



TWIN OR REFLECTION? In this case it is a twin. The dog in the foreground posed for its photograph just when, as chance would have it, a dog in the yard next door posed in exactly the same manner. Annette Parguey, of Howard Beach, L. I., snapped the picture at just the right time.

MOTORBOATING can be more pleasant than it seems in the photo below. Some unwary driver had left his car parked on the beach, and the tide beat him to it. J. C. Soderblom, of Jacksonville, Fla., also happened by with his camera before the driver showed up.



THIS CHANDELIER OF BULLETS was made at the Ford Willow Run testing field where Liberator bombers, manufactured at the rate of one an hour, try out their .50-cal. machine guns. The giant magnet retrieves the spent bullets from the backstop so that they can be melted down for salvage.



GAS WITHOUT COUPONS was a lucky break for this boy who had a can handy when a gasoline tank truck went over a bank and 3,500 gal. of gasoline were spilled. Which all goes to show that even an ill wind can blow someone some good. H. T. Warren, of East Braintree, Mass., had a camera instead of a can.



Light is directed past the revolving wire drum to simulate dancing waves

SPECIAL EFFECTS for independent Hollywood producers are a specialty with Lee Zavitz, who achieves remarkable movie illusions with the ingenious use of commonplace materials. To obtain the effect of a sky filled with cumulus clouds, Zavitz directs a strong light through a pane of glass that has been daubed with shoe whitening. The result, projected on a background screen, is a convincing illusion of reality. For a long shot showing the rugged Maine coast as a distant horizon, he used chicken feathers glued to a model of terrain to simulate weatherbeaten trees along the bleak shore. In a "process shot" that called for rippling waves on water, he

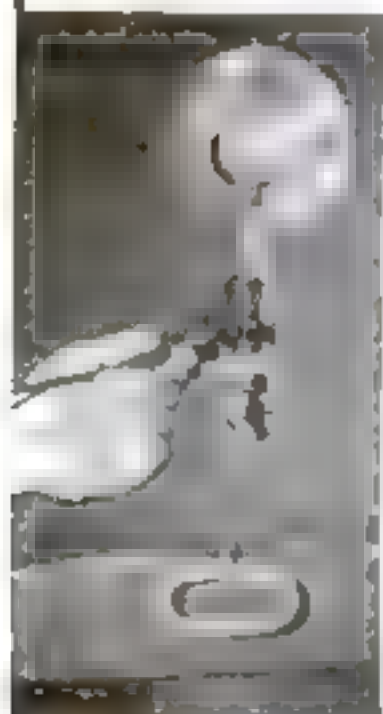


A glass plate daubed with shoe whitening is the heart of this ingenious illusion. The gaunt tree is a prop in the studio



To get weatherbeaten trees, Zavitz glues on chicken feathers

used the equipment shown at left above, in which light is projected past a slowly revolving wire drum to a background screen. These effects were staged for a Hunt Stromberg production called "Guests in the House."

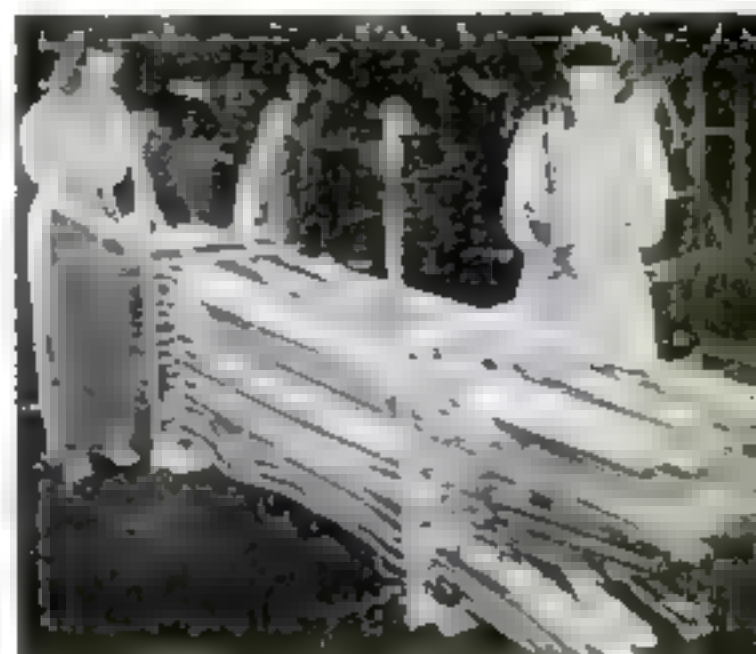
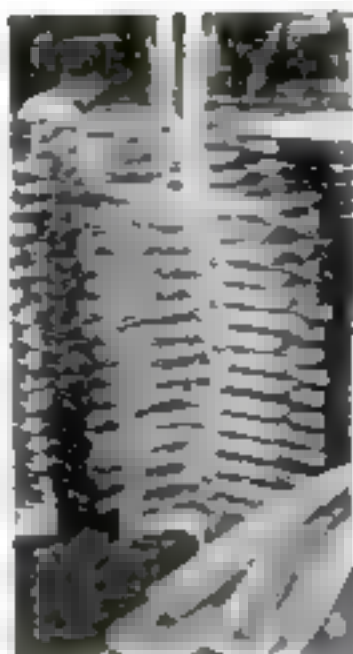


PHOTOFLASH EXTENSIONS may be given greater flexibility with the use of a three-way socket as at the left. By using such a socket with two 15' extension cords—which would otherwise let the bulbs be placed only 15' away from the camera—you can place one 15' away and the other as much as 30' away.—L. H.

A CRACKED PLATE at the top of a tilting tripod head, often caused by strain, age, or careless handling, can be replaced with a piece of the molded plastic paneling commonly used for switchboards. Remove the damaged plate, use it as a template to mark the paneling, and drill it to receive the mounting bolts and camera screw.—W. E. B.

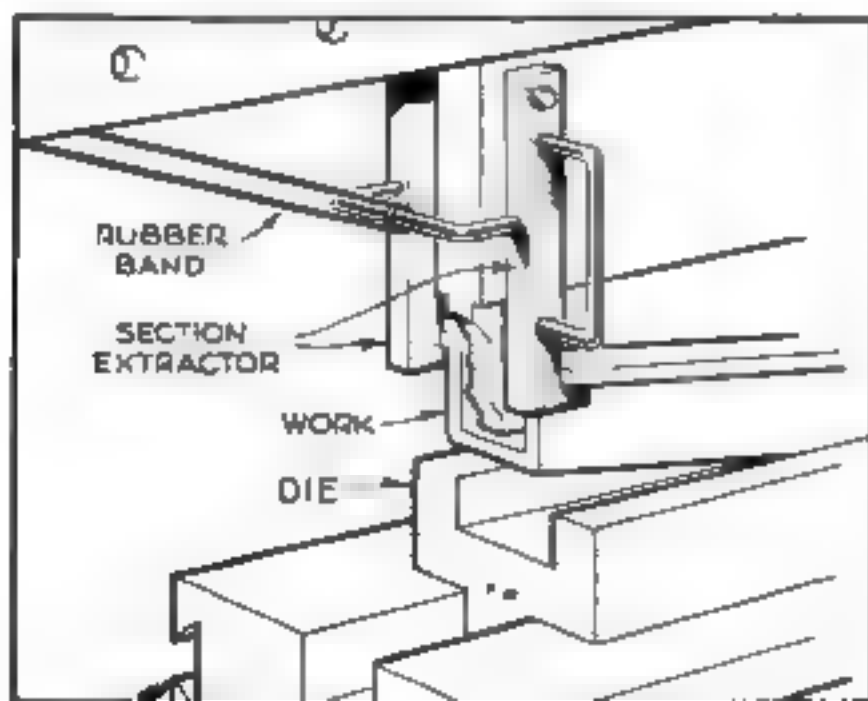


ADJUSTABLE RACKS designed by employees of the Glenn L. Martin Company have almost halved the time required to load formed parts for insertion in an anodizing tank. One type of rack consists of a center post with a toothed frame at the bottom; work is stacked log-cabin-style about the post and held at the top by an adjustable pressure plate. A hook at the top of the center post facilitates handling on an overhead conveyor. Another rack, used for longer work, consists of two posts separated by means of two channel sections.



LACQUERING THE GLASS in welders' shields and goggles has been found to increase greatly the resistance of the glass to scratch burns. In continuous spot welding it has been sometimes found necessary to change glass three times a day because of lowered visibility caused by scratch burns; yet lacquered glass has been used for as long as five weeks, after which it was necessary only to remove the coating and relacquer to continue using the same piece of glass. The idea was developed by Lafean Stine and S. Cyril Ertter of the York Safe & Lock Company, of York, Pa., after they noticed while welding a safe that sparks did not stick on a lacquered surface. They report that dipping the glass in lacquer gives the most durable coating.

SHEET-METAL SECTIONS pressed in forming dies at the Northrop Aircraft plant in Hawthorne, Calif., were difficult to remove by hand, and the use of pinch bars often damaged finished ones. An extractor devised by sheet-metal operators Mel T. Patch and Lee Howerton now removes sections from the die in a quarter of the time previously required, and without injury. It consists of two L-shaped bars connected by a crosspiece and hinged on pins that project from the male die. Both bars are shaped into hooks at the lower ends. A rubber band holds the device free of the work during forming. When the section is finished, the operator swings down the extractor so that its hooks engage the work. As the die is lifted, the section is pulled out.



WIRING BOARDS, on which intricate groups of wires and cables can be assembled, are the suggestion of W. L. Jackson (at left above) and John Downes, Westinghouse employees. The boards are used as an adjunct to the construction of complex switchboards, replacing the difficult and tedious job of wiring each board strand by strand. Under a suggestion-award system, Jackson received \$1,832.25 for the idea, and Downes was given \$610 for assistance in working out the details.



2,000-Degree

By ERVIN WALTERS

for auto grease. The shell shown was a compressed-air tank 12" in diameter. Cut off enough of the top to trim the shell to a length of about 12". Drill two holes to receive $\frac{3}{4}$ " pipe—one about 4 $\frac{1}{2}$ " from the bottom and the other on the opposite side, 3" or so from the top. The lower hole is the intake through which the gas-and-air mixture enters the furnace chamber. The other is an exhaust, which functions when the top of the furnace is covered.

Spread a $\frac{3}{4}$ " layer of dry sand over the bottom of the shell. On this, lay 2 $\frac{1}{4}$ " firebrick, trimming it to fit. Use half-width firebricks, known as "soaps," to line the cylinder. Ten soaps, each 2 $\frac{1}{4}$ " by 2 $\frac{1}{2}$ " by 9", were used in the furnace shown. Two of them should have holes for the $\frac{3}{4}$ " pipe. The lower hole should be cut on a bias so the intake pipe, when put into position, will be roughly tangent to the fire chamber. Set the soaps in high-pressure furnace cement. Use the same cement to fasten them together along their vertical edges. Fill the triangular spaces between the soaps by ramming into position a mortar made by mixing equal parts of fire clay and pulverized firebrick—or fire clay and sand—with enough water to form a stiff, rather dry paste.

Dry the furnace thoroughly before you use it. To hasten the drying-out process, suspend a 100-watt lamp inside the fire chamber while you make the other parts.

A GAS-FIRED furnace is almost a "must" when you want to heat-treat or carburize steel; melt aluminum, brass, and similar metals; or perform any other operation that requires temperatures up to 2,000 deg. F. Such a furnace, built primarily for salt-bath treatment of tool-steel parts at temperatures in the neighborhood of 1,500 deg., is shown in the accompanying photographs. Scrap materials were used for the most part in building it.

Make the outer shell from a metal tank, a large paint can, or one of the kind used

One way of making holes in the shell for the $\frac{3}{4}$ " pipe is to drill a $\frac{1}{2}$ " hole and then to ream it to size with a 1" taper reamer. Finish the reamed holes with a file to smooth the edges

Use firebrick "soaps" to line the fire chamber, placing them on edge and securing them to the firebrick bed with a good high-pressure furnace cement

Mix fire-clay mortar and ram it into the spaces between the soaps. The fire chamber has here been plastered up with black furnace cement



Gas Furnace for the Shop

Make a cover from two firebricks with a narrow space left between them; or, for easier handling, mold a doughnut-like cover out of the fire-clay mortar; or use an old grindstone of the proper diameter.

The fuel system consists of a blower, an air-and-gas mixing chamber, and connecting piping. The blower shown is an old vacuum-cleaner motor, complete with fan and housing. An ordinary hair drier without the heating coil could have been used, but the bearings in such a drier are not rugged; so they may not last under extensive service. Lacking either a vacuum-cleaner motor or a hair drier, you can adapt any induction or universal motor by adding a fan and a housing. These may be made from tin-can material. Provide a sliding or swinging cover over the intake opening of the fan housing to regulate air volume.

Although a constant blower speed is practicable, the illustrated motor was equipped with a rheostat to reduce the speed to a usable level and to provide control. This was taken from an old motion-picture projector and connected in series with one motor terminal. In series with the other terminal was wired a porcelain lamp socket. The wiring diagram is shown at the bottom of page 184. Experiment showed that a 100-watt lamp in the socket was just right for reducing the speed of this particular motor to the proper range. Another resistance unit that might have been used is

a water rheostat (see P.S.M., Nov. '44, p. 171). If you don't have a rheostat or the inclination to assemble one, you can create a resistance by wiring one or more lamps in series to reduce the speed of the motor to about 1,500 r.p.m.—you can determine the best speed when the furnace is in operation.

The method of mounting the blower depends on its design. That illustrated rests on a horizontal plywood board that is supported by two blocks. The rheostat and lamp are mounted on the same board, and the air intake is underneath, between the two supporting blocks. A guard made of $\frac{1}{4}$ " mesh screen protects the lamp.

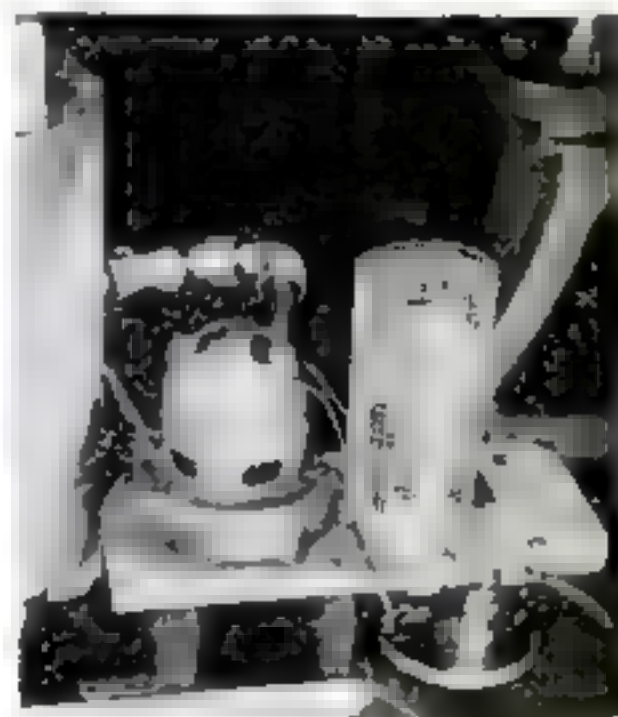
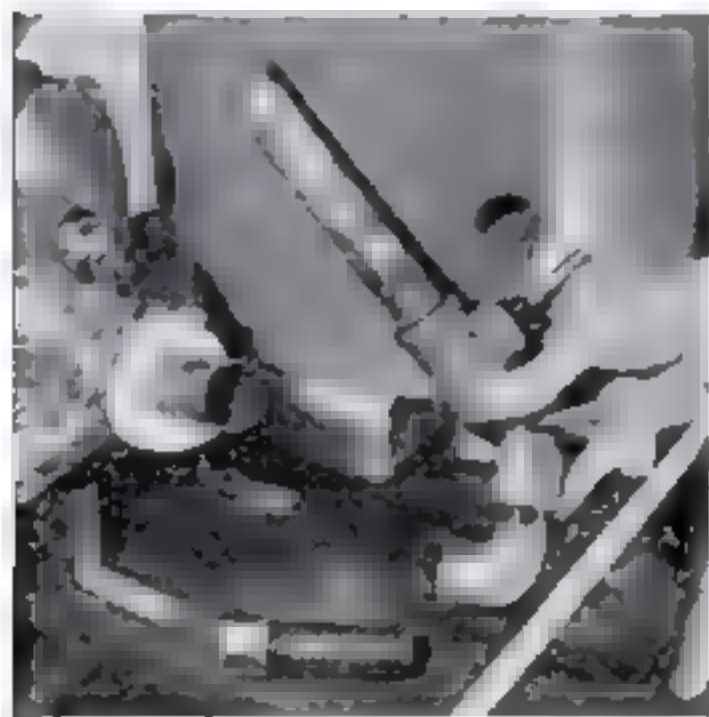
Put a fitting on the discharge side of the fan so it can be coupled with the $\frac{3}{4}$ " pipe system. For the blower shown, a pickle-bottle lid, with a hole in it over which was soldered a length of $1\frac{1}{4}$ " brass tubing, was used. A short $\frac{3}{4}$ " nipple, threaded at one end and with the other end built up with sheet metal to fit snugly inside the brass tubing, was then inserted. To this nipple was screwed a 90-deg. street ell, which was, in turn, coupled to a 45-deg. street ell. This was screwed into a tee, care being taken to place it at one end of the run rather than at the take-off. To the other end of the run, a longer nipple was added. The free end of this nipple was cut to a bevel to conform roughly to the inside curve of the furnace.

The gas jet goes into the take-off of the tee. It is a 4" length of $\frac{1}{8}$ " pipe or $\frac{3}{16}$ "

This shows the way the pipe fittings are arranged to connect the blower and the fire chamber. Note the beveled end of the pipe, which roughly matches the inside curvature of the fire chamber

As described in the text, the mixing chamber holds a tube, which acts as a gas-injection nozzle. When it is in place, the jets must face the furnace

Mount the blower, rheostat, and ballast lamp on a base that is made from a piece of plywood. Here the air intake is below the support





tubing and runs through a hole drilled in a standard pipe plug, which is screwed into the take-off. The inner end of the tube is flattened for a distance of $\frac{3}{4}$ " so the inside walls are about $\frac{1}{16}$ " apart, and then soldered shut. Four or five holes are drilled with a No. 50 bit along one of the resulting edges. The jet must be positioned in the tee so these holes open toward the furnace end of the pipe system, as shown in the drawing at the bottom of this page. Use a length of approved gas hose to connect the jet to the nearest domestic-gas outlet.

A convenient stand, shown above, was welded up from scrap material. It is bolted to a base that is made from 2" by 8" pine and equipped with four sturdy casters.

This furnace will produce a flame that is roughly spiral in shape and somewhat uneven in intensity. This unevenness is not objectionable when the work is held in a crucible. If a more even flame pattern is desired, install two inlet pipes virtually tangent to the fire chamber and on opposite sides, as shown below. When using a crucible, set it on a circular piece of firebrick



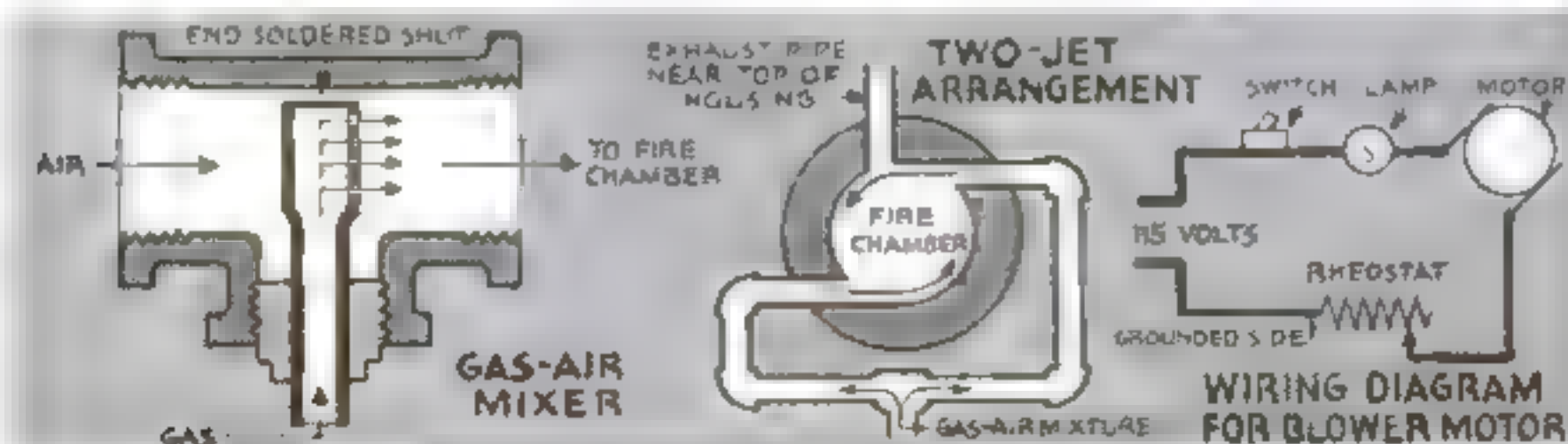
You can make your own crucibles from sections of 4" steel pipe by welding disks in position to form bottoms. Each container should be about 7" high

At left, the completed furnace mounted on a stand that was designed for mobility. Finish the outside of the fire chamber with a coat of baking enamel

that is placed in the middle of the chamber.

Some experimenting may be required to get the right gas-and-air mixture. If the flame billows out of the furnace without much roar, you need more air or less gas. If it jumps around or goes out, you need more gas or less air. The flame will roar steadily when properly adjusted. Use a taper at least 18" long when lighting the furnace and always have the room well ventilated. Most of the heat thrown out will be projected upward; so some overhead shielding may be required.

Probably the mortar work will not be bone dry when you light the gas the first time, even though the furnace has been drying for a week or so. For this reason, operate the furnace just long enough to warm up the fire-chamber walls. After an hour or two, warm the walls to a little higher degree. Repeat this process until you are reasonably sure that all moisture has been driven out. Otherwise imprisoned water may cause an explosion that, at best, will damage the furnace lining and, at worst, will injure persons in the vicinity. Once dried out, and with adequate ventilation, the furnace is as safe as any comparable piece of shop equipment.

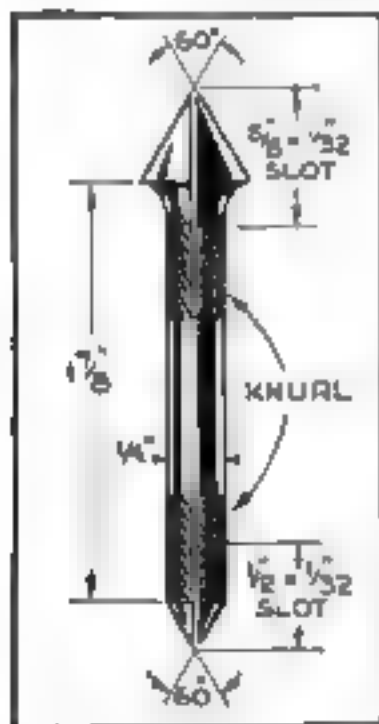
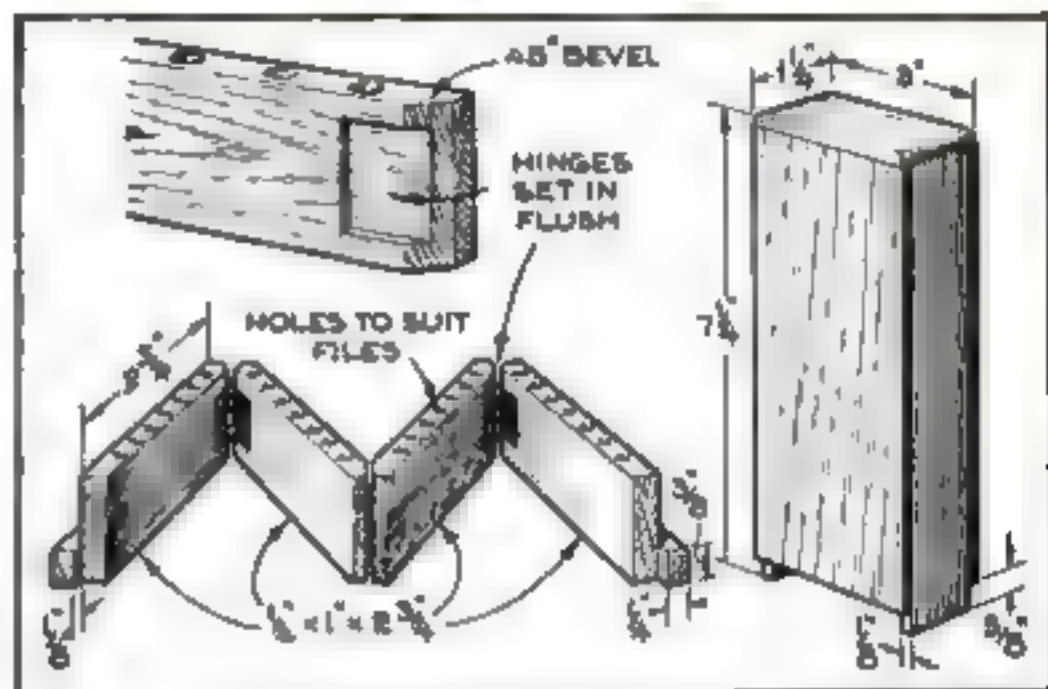




SWISS NEEDLE FILES are easily broken if kept with heavier tools. This case, small enough to fit into a machinist's tool box, accommodates 28 files and unfolds as a bench stand.

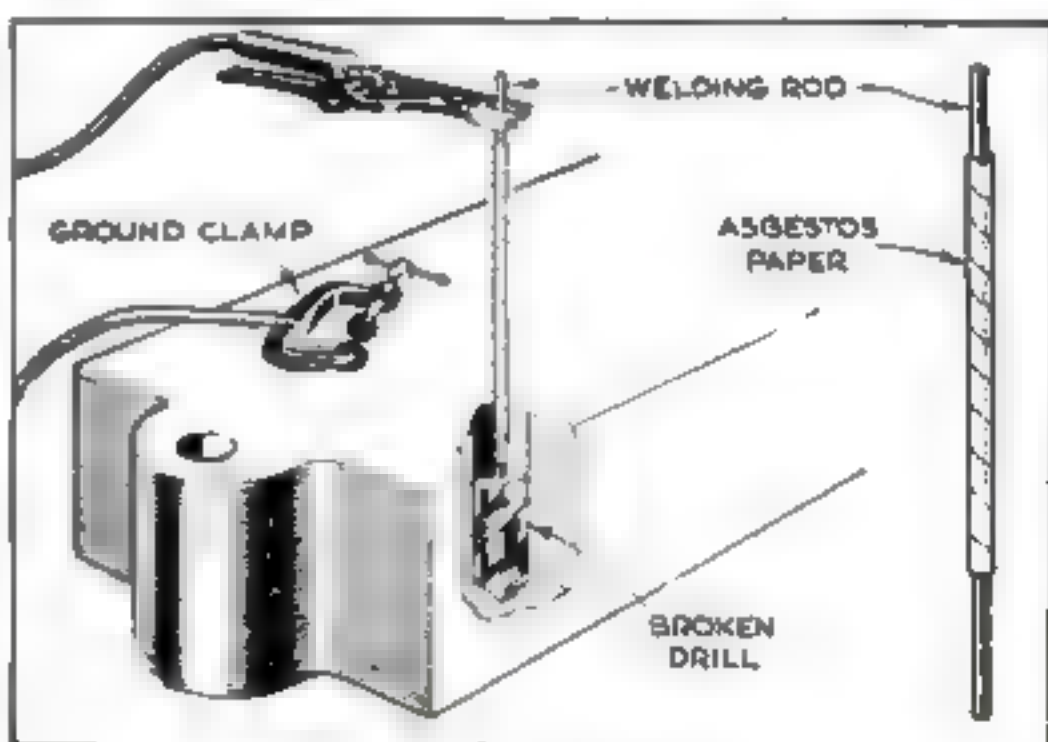
Make the case of $\frac{1}{4}$ " mahogany to the dimensions shown, assembling it with glue only and rounding all edges and corners. The base consists of four sections hinged together. When folded, it should fit snugly into the case. To prevent it from entering too far, glue small strips to the bottom edges of the outside sections as shown.

Holes $\frac{1}{8}$ " deep and $\frac{1}{4}$ " apart are drilled in each section to receive the files. A stain and oil finish completes the case.—F. MCC.

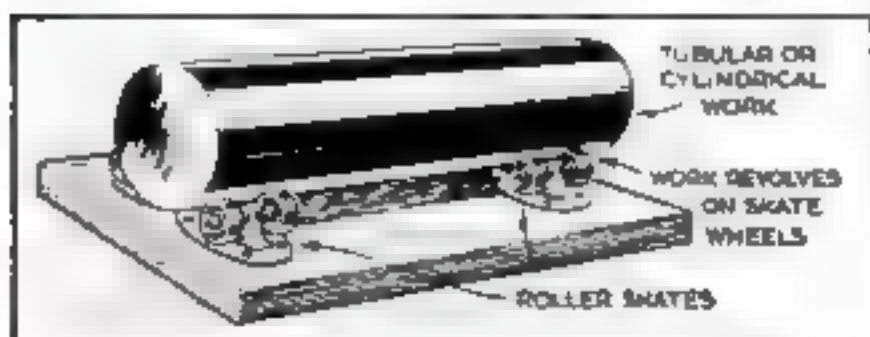


CENTER HOLES must be free from chips or dirt if accurate lathe work is to be done. They can be cleaned quickly with the device shown at the left, which can be turned in a few minutes from any bit of scrap rod. Dimensions are not important, but the angle of both cones should be exactly 60 deg.

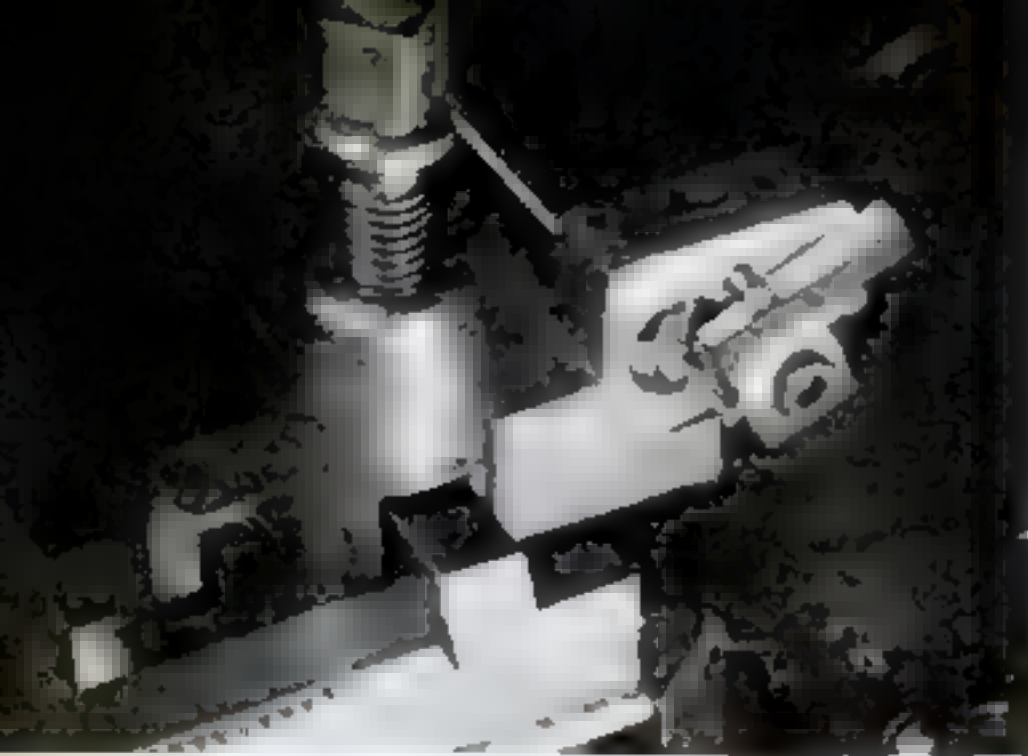
In use, a piece of thin cloth— $\frac{1}{4}$ " by $\frac{1}{4}$ " is a good size—is slipped into either slot and twisted about in the hole.—C. J. JESNIG.



CYLINDRICAL WORK is easily marked, soldered, or welded on this support, as it can be turned to any position without rolling it all over the workbench. The beel flanges were cut off two old roller skates and the skates were screwed fast upside down to a heavy baseboard. This arrangement saves much working space on a crowded bench.



A BROKEN DRILL embedded several inches deep in a big casting was removed by a welder as shown above. He first wrapped a welding rod with asbestos to prevent it from arcing against the sides of the hole, but left the tip bare. The ground clamp was laid on the casting and the rod inserted to strike an arc against the drill. When he felt the rod had fused with it, the welder broke the circuit by lifting the ground clamp. The drill could then be lifted out by the rod, saving the casting.—JOHN KRILL.



TRICK LATHE TOOL DOES SLENDER TURNING

By W. A. Conway

TURNING long, slender work is an irksome job at best and sometimes almost impossible with the ordinary lathe steady rest; but here is a combination steady rest and tool that permits reducing the diameter of drill rod for nearly its entire length. With the stock inserted in a hardened guide bushing made to fit, it can be turned down from the end to within reasonable distance of the chuck. Interchangeable bushings permit handling work of diameters up to about $\frac{1}{4}$ ".

The shaft shown was designed for a cross-slide turret block, but it can be clamped on the conventional compound rest, as shown in the photos, or the design may be changed if desired. Such a tool also works successfully in a drill press, the holder being clamped to the table and the stock to be reduced being held in the chuck.

One of the photos shows the parts before assembling along with two wrenches for the hollow-head screws. These parts are a body, a bushing, a $\frac{3}{16}$ " by $\frac{3}{16}$ " by $1\frac{1}{2}$ " high-speed steel bit, an L-shaped clamp, two $\frac{1}{8}$ " steel pins $\frac{1}{2}$ " long, a $\frac{3}{16}$ "-32 hollow-head cap screw $\frac{3}{8}$ " long, and two 6-32 setscrews $\frac{1}{4}$ " long for controlling adjustment of the guide bushing.

Cut the body from $\frac{1}{2}$ " steel bar or plate, using a metal saw for roughing out and a grinder or abrasive wheel for finishing, and drill and ream the hole for the bushing. Turn the bushing from tool steel, drill and ream its hole to the size of the stock to be handled, and countersink the end the stock

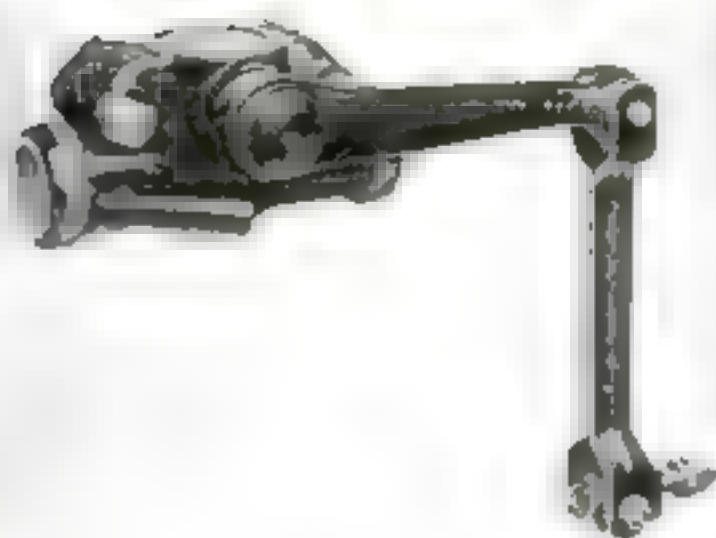
enters. Cut notches to form the tongue with a saw and file. Install the bushing temporarily, with the tongue in the vertical position, and scribe a deep, permanent straight line across it and the body for use in aligning and making fine adjustments.

The two pins projecting $\frac{3}{16}$ " from the body hold the bit in position, and it is secured by the L-shaped clamp. Note the overhang in the drawing that keeps the clamp from turning on the body when the cap screw is tightened. The extent to which the bit projects over the bushing hole determines the turned diameter of the work. Set the bit roughly with the help of a scale and make a test cut; then make fine adjustments by loosening one setscrew and tightening the other to shift the bushing.



Question Bee

Can you name these automobile parts?

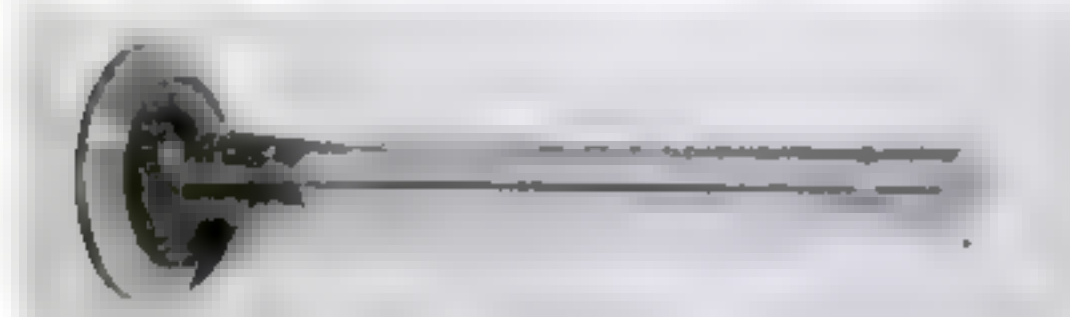


1.



3.

2.



4.

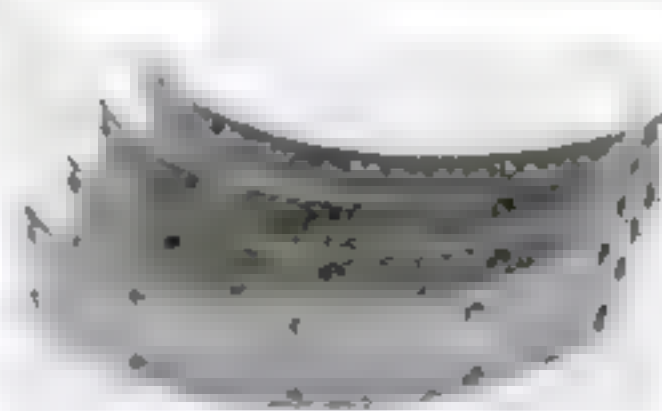


5.



6.

8.



Photos courtesy General Motors

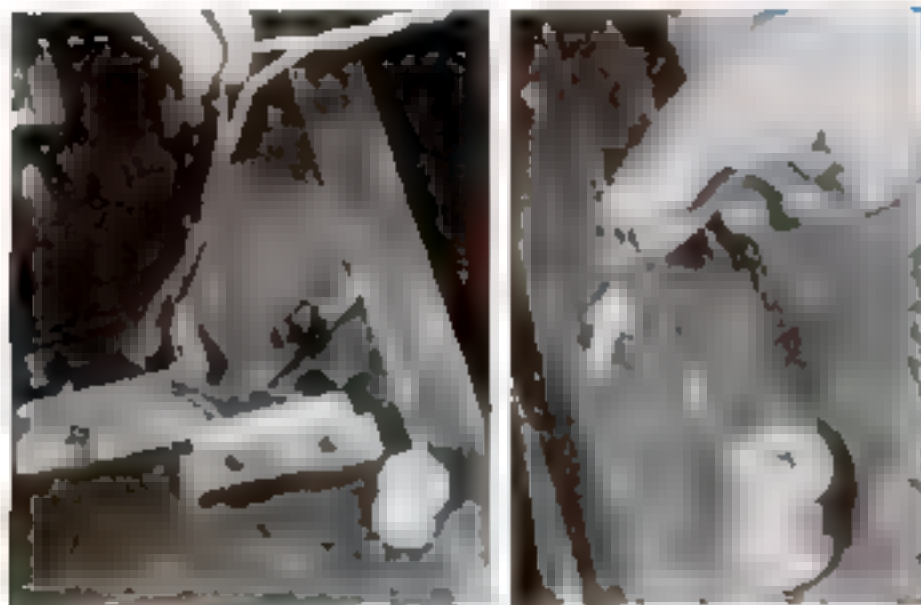
5. Piston, two compression rings, and one oil-control ring.
6. Generator brush.
7. Sealed-beam headlight unit.
8. Brake lining.

ANSWERS

1. Crankshaft.
2. Camshaft.
3. Shock absorber.
4. Valve.

String Controls Switch in Two-Tool Setup

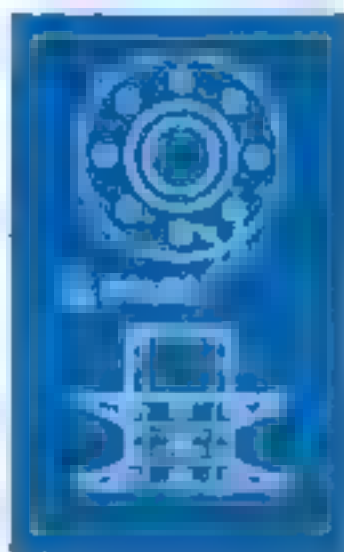
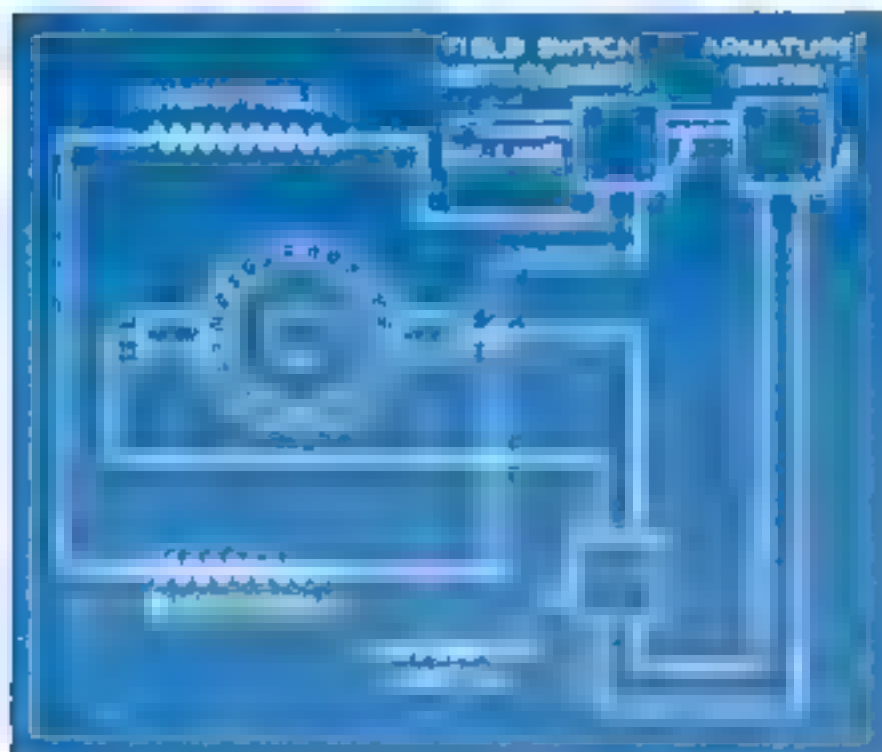
THE string-and-spool switch arrangement shown in the drawing and photographs was originally devised as a temporary measure to give convenient control of a motor that operated two power tools. It has, however, given good



service for more than five years. Three common spools, fastened to the bench with wood screws, serve as pulleys for a continuous loop of stout linen cord that is held taut by a coil spring. Attach the cord to an extension on the handle of a single-pole knife switch. A slotted cover for the switch (not shown) was also added. The spring acts as a handle at one end of the loop, and a split and glued dowel gives a finger grip at the other. For minimum friction, wax the cord or use two small silk-thread spools on a single axle for the middle pulley.—W. B.

Circuit for D.C. Shunt Motor Needs No Starting Rheostat

ORDINARILY a rheostat or other starting resistance is used in the armature circuit of D.C. shunt motors to limit the current that would otherwise flow at first through the armature windings because of their low resistance. The second control that this involves is sometimes inconvenient, especially with automatic equipment. To dispense with the rheostat, use the circuit shown below, bringing out separate leads from the field and the armature if these are not already supplied. The field is connected to the line through a safety switch that is normally kept closed. The motor can then be started by the armature switch without flashing over at the brushes.—HAROLD P. STRAND.



Holes in Pulley Reduce Slip

BELT slippage is sometimes a problem on V-belt drives if one of the pulleys is small, as on a circular saw. I found that I could eliminate slippage on my saw by drilling a series of $\frac{1}{8}$ " holes through the $1\frac{1}{2}$ " pulley, spacing them $\frac{1}{4}$ " in from the outer edge. Two additional holes were drilled at right angles to each other through the center of the pulley, and all burrs were carefully smoothed off. Care must be exercised in drilling to avoid drill breakage on the slanting inner surface.—W. H. KISSEL.

Plaque Conceals Light Switch

TO HIDE the light switch in his study and to add an unusual decorative touch, one home owner covered it with an ornamental plaque, pinned as shown to the toggle of the switch. Pressing up or down controls the light.—K. M.

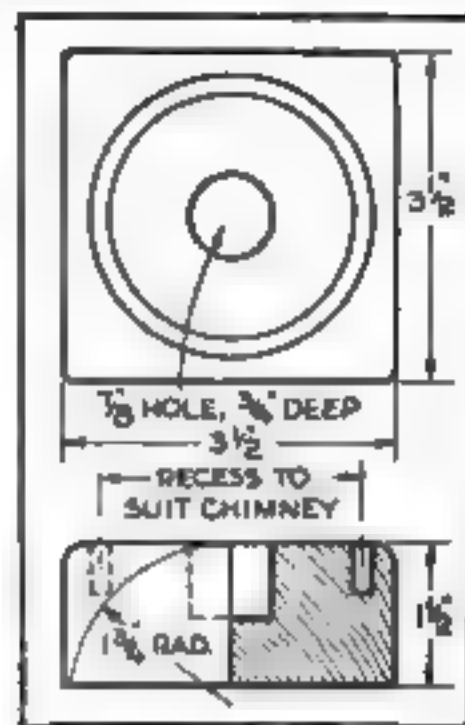




Decorative Hurricane Lamp Turned of Hardwood

ONE or a pair of these hurricane lamps will make good-looking ornaments for a living room or dining room and will be found useful in warm weather for lighting a porch or terrace. A $1\frac{1}{2}$ " by $3\frac{1}{2}$ " by $3\frac{1}{2}$ " hardwood block is required.

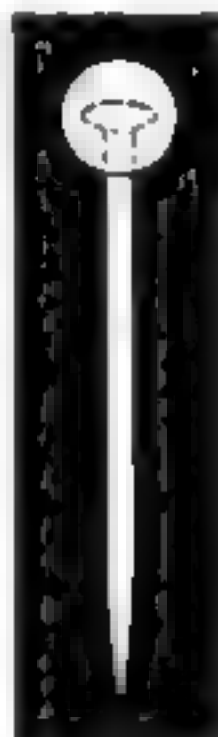
The circular recess for the chimney is easily cut with the piece mounted on the faceplate of the lathe. Although the dimensions given in the drawing are fairly standard, it is safer to take them from the chimney to be used, for chimneys may be found to vary slightly. Round the corners while the piece is still in the lathe. Finish to blend with the room furniture.—NORBERT ENGELS.



Button Bunny Put on Place Card



THREE buttons of different sizes sewed to the front of a folded sheet of mat stock form the head, body, and tail of an attractive place-card bunny. Draw in the ears and paws with crayon and add a bow of yarn, tying it on the underside of the card, which is folded so as to stand upright.—B. N.



Map Markers Made from Common Pins

WITH map pins in demand, you may wish to make your own. Hold the point of a common steel pin with pliers, heat the head cherry red, and plunge it into a dish of household borax, a small amount of which will adhere. Heat this until it fuses into a ball of borax glass. Dip the head into powder again and reheat to increase the size. When cool, dip it in colored enamel.—KARL J. BURG.

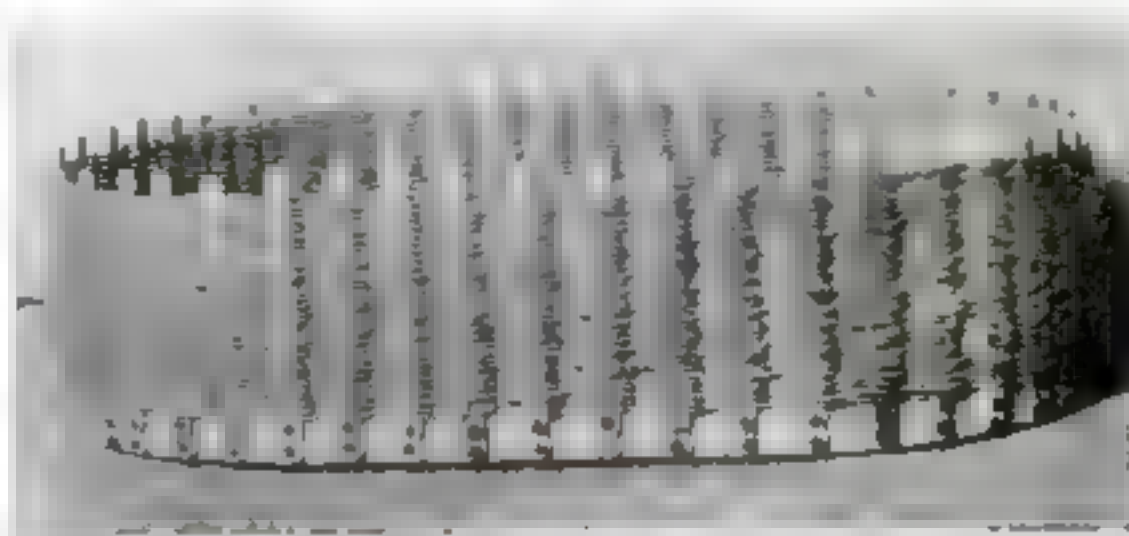
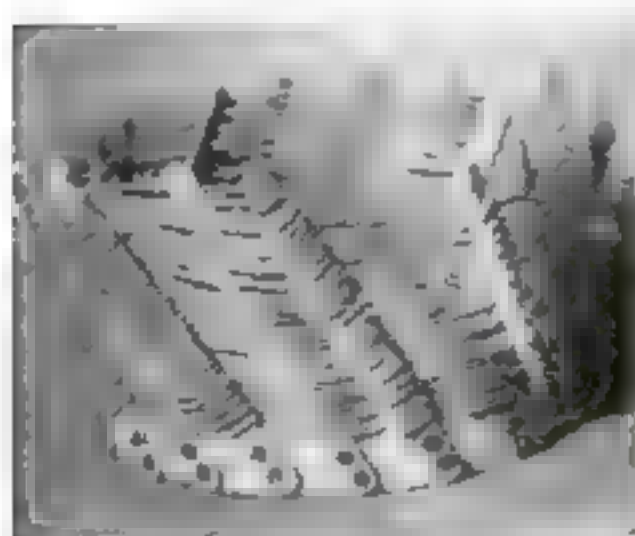
Wrapping Cord Woven into Baskets Around Ice-Cream Sticks

SIMPLE yet interesting baskets can be woven with materials no more elaborate than ordinary wrapping cord and the sticks from popular types of ice cream.

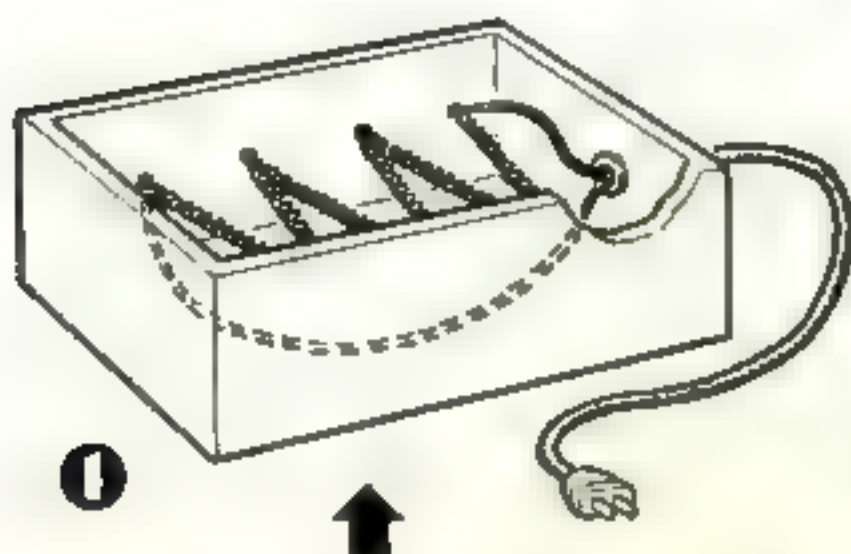
Use a soft pine board $\frac{3}{4}$ " to 1" thick for the base, cutting it to shape with a coping saw. Drill two tack holes in one end of each stick and attach the sticks no more than 1" apart around the circumference of the base.

Glue an end of the cord to the base behind a stick, and then weave it in any pattern. That shown at the right below is a simple loop around each stick; that at the left is a loop around every other stick. Where a stick is skipped as in this case, the number used must be even.

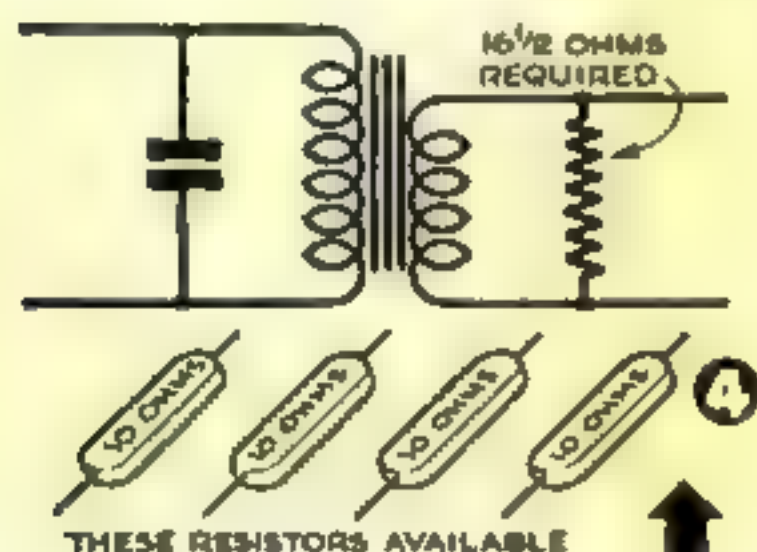
Bevel the side of the base for a wide-topped basket.—J. LEORA BROWN.



Wiring Puzzlers to Test Your Electrical I.Q.



TO MAKE a photographic dryer, Smith used a 600-watt replacement coil sold for use in toasters and stretched it over a series of hooks inside an asbestos-lined box. But he found the wire heated to redness, scorched the prints, and threatened to burn the box itself. To halve the amount of heat, should he cut the resistance wire in half, add a second element in series, or connect another in parallel?



A RADIO engineer, needing a $16\frac{1}{2}$ -ohm resistance across an amplifier transformer for testing purposes, found he had nothing but four 10-ohm resistors in his parts drawer, which therefore had to serve. How did he connect them?

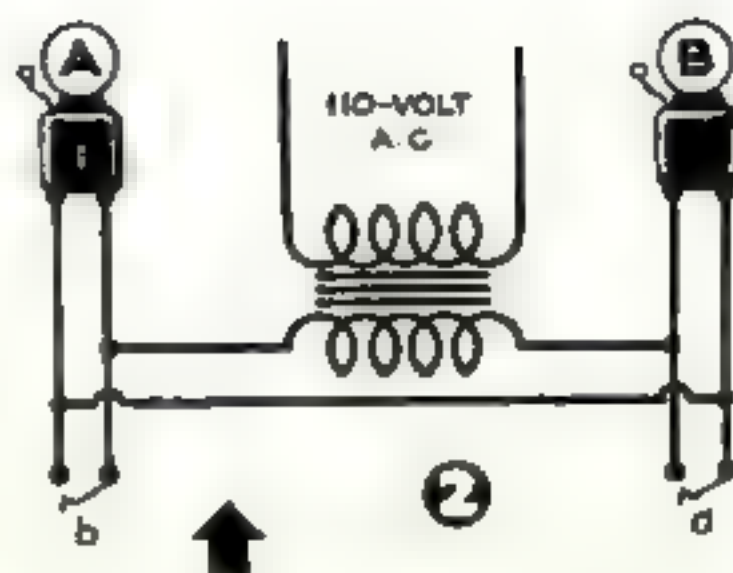
Added to the unshunted resistance, this gives a total of 16.6 ohms.

$$\frac{20 \times 10}{20 + 10} = \frac{200}{30} = 6.6 \text{ ohms.}$$

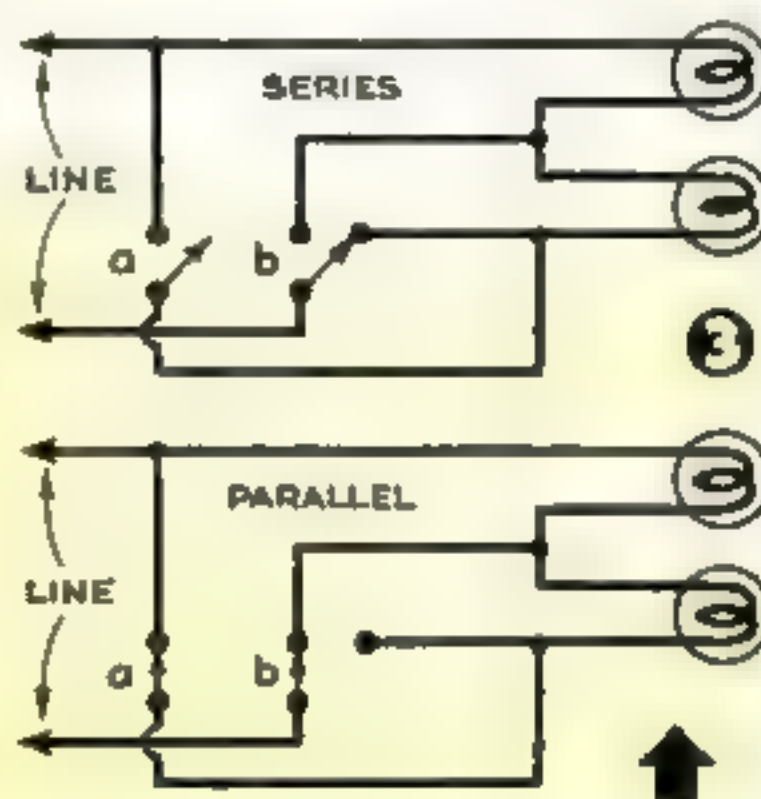
Substituting known values.

$$\frac{R_1 + R_2}{R_1 \times R_2}$$

for parallel resistances is: The formula two of them with the fourth. The formula



WISHING to save wire, Jones hooked up two bells this way. Button *a* was to ring bell *A*, and button *b* bell *B*. Although pushing both buttons at once would cause a short circuit, Jones thought this would be of too short duration to harm the transformer, and he expected no trouble. He had trouble anyway. Why?



NOT having a double-pole, double-throw switch on hand, a photographer connected a S.P.S.T. switch *a* and a S.P.D.T. switch *b* as above to throw two flood lamps from series to parallel or vice versa. As all worked well in the positions shown, he considered himself lucky. Why was he even luckier than he thought?

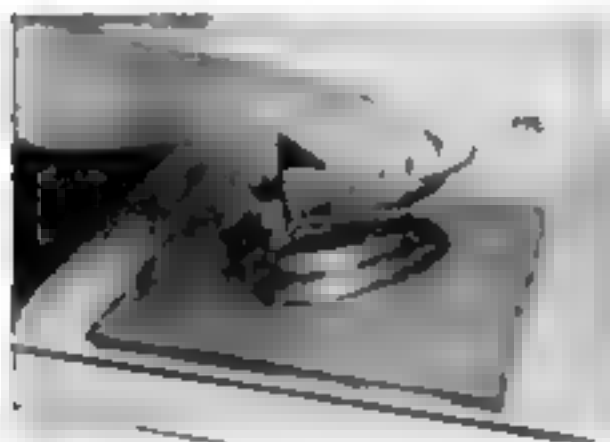
4. Put three resistors in series and shunt satisfactory way. Can you do it?

possible to connect these switches in a safe and fuses will be blown. But it is thrown to the right, a short circuit re-

3. If switch *a* is closed while switch *b* when neither button is pressed.

2. The bells will ring continuously even the first, thus halving the current.

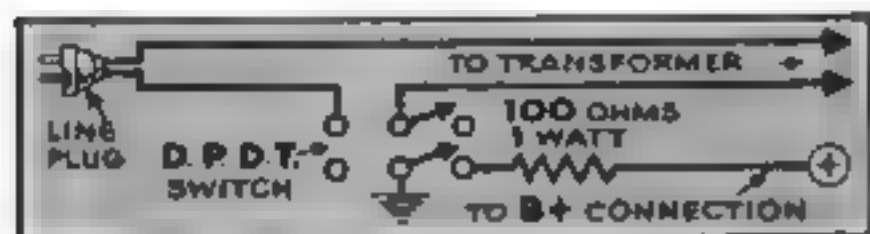
1. Add a second element in series with



WARPED PHONOGRAPH RECORDS that slip against other records on an automatic changer can often be straightened simply by placing them between glass and leaving them in a warm place for a few hours. Use two scrap pieces of plate glass at least 12" square and lay a sheet of paper between each surface of the record and a glass to avoid damaging the grooves. Put a weight, such as an electric iron, on top. A shelf over the kitchen range, or some similar spot, should provide sufficient warmth to take out the bend.

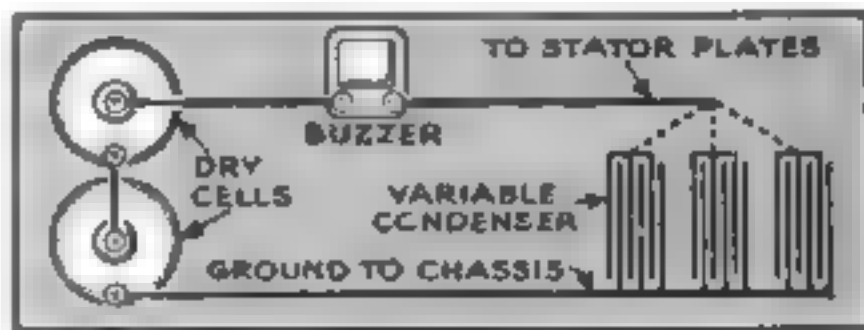
Occasionally a record so straightened will retain a slight curve that permits the convex surface to slip. This can be corrected by repeating the straightening operation with a 4" circle of heavy paper or thin cardboard on the center of the convex side.

Slipping usually occurs when a record is so warped that the drag of the needle is greater than the drag of the record on the one below it on the automatic changer. Two adjacent records in a set may be warped and still fit together in such a way that they do not slip. In such a case straightening is unnecessary.—WILLARD ALLPHIN.



SAFETY CAN BE ASSURED in working with experimental high-voltage electronic equipment by incorporating a double-pole double-throw switch in the circuit, as shown in the diagram above, instead of the customary line switch. This acts on the same principle as the more expensive and hard-to-obtain interlock switches, permitting the condensers to discharge automatically when the switch is thrown over. The resistor is added to prevent excessive sparking at the contacts. Since the discharge takes place in a matter of milliseconds, a 1-watt resistor is adequate.—GEORGE O. SMITH.

SHORTS IN A CONDENSER, such as are apparent when a radio goes dead over part of the dial, can be traced quickly by rigging up a homemade tester consisting of two dry cells and a door buzzer. Disconnect the stator leads and connect the cells and buzzer in series with one section of the condenser at a time, as shown below. Then slowly rotate the condenser back and forth, watching the segments closely. A short will show up as sparks between the plates, which can then be straightened.—OTTO H. MILLER.



MEASURING IMPEDANCES

[ELECTRICAL]

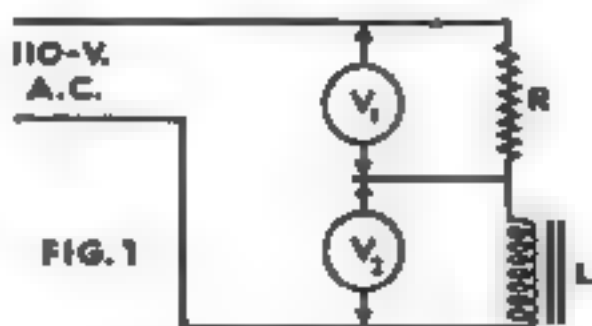


FIG. 1

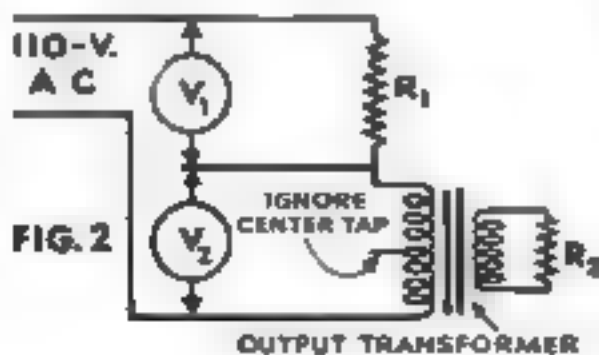


FIG. 2

With the aid of an ordinary A.C. voltmeter it is fairly easy to measure the actual impedance value of chokes, output transformer and large paper condensers. If you have an impedance-frequency chart, the impedance measurements so determined can be converted to henries or microfarads.

In Fig. 1, R is a known resistor approximately equal to the impedance of the inductor but to prevent overheating not less than 2,500 ohms, while L is the choke to be measured. Read V_1 and V_2 with the A.C. voltmeter, then use the following formula:

$$\text{Impedance of } L \text{ in ohms} = \frac{R \times V_2}{V_1}$$

If R is 4,000 ohms, V_1 is 88 volts and V_2 is 22 volts, then $L = \frac{4,000 \times 22}{88} = 1,000 \text{ ohms}$

When impedance readings are made on transformers, the secondary must be loaded with a resistor of the value of the speaker to be sold normally used. The correct pair of secondary taps to match an 8-ohm speaker to a required output can be determined by measuring the impedance of the transformer with an 8-ohm resistor across different secondary taps.

In Fig. 2, R_1 is a known resistor approximately equal to the impedance of the transformer but to prevent overheating not less than 2,500 ohms and R_2 is a resistor equal to the impedance of the normally used speaker to be sold. For push-pull transformers use the two plate taps and ignore the center tap. Then as with chokes, read V_1 and V_2 and use the following formula:

$$\text{Impedance in ohms} = \frac{R_1 \times V_2}{V_1}$$

If R_1 is 2,000 ohms, R_2 is 8 ohms, V_1 is 60 volts and V_2 is 50 volts, then impedance = $\frac{2,000 \times 50}{60} = 1,666 \text{ ohms}$

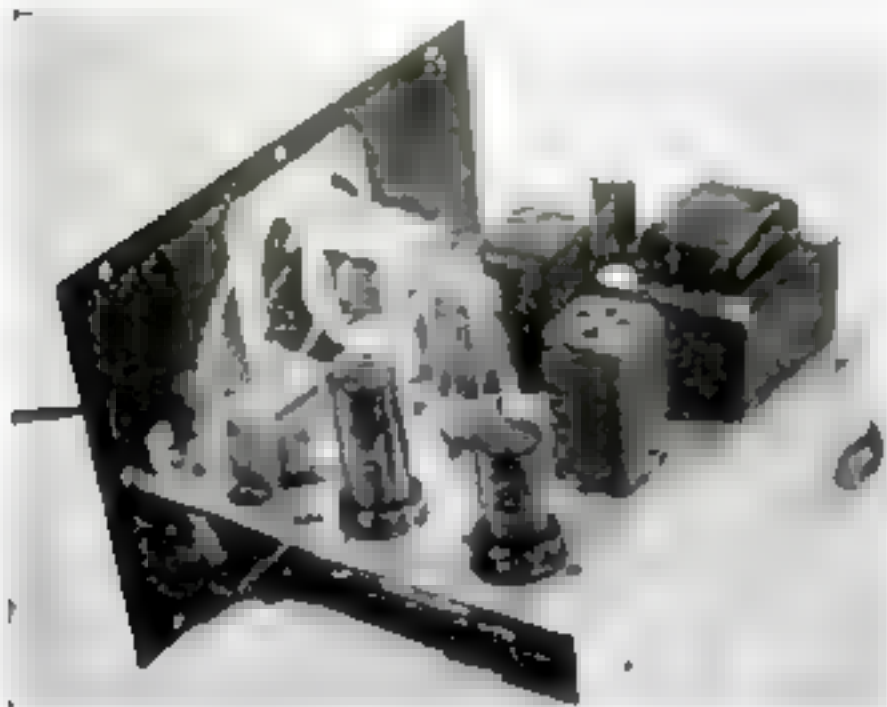


COMPLETING YOUR CARRIER-CURRENT RECEIVER

PART II

WITH strict wartime prohibitions against the use of radio transmitters by amateurs, and with sharp-eared Government monitors waiting to pounce on the source of any unauthorized transmission, many a radio experimenter has found carrier-current communication the best legal outlet for his energies. Though similar in many respects to radio, this method of transmission differs in that the signal is not radiated generally, but is instead merely fed into a wire. At some other point a receiver connected to the wire picks up the signal.

These photos of the receiver show its simplicity. Note the absence of the ordinary tuning condenser



Just as all radio signals are radiated into the ether, from which they can be selectively received by tuned circuits, a number of carrier-current signals can be led along the same wire at the same time. This selective characteristic means that a carrier-current signal can be sent right over the same power line that supplies 110-volt A.C. to your house, and taken off elsewhere by a suitably tuned circuit.

Thus it's quite practicable to build for yourself a transmitter and a receiver that, plugged into light sockets, will give entirely private communication between two separate

points. One of the most useful applications is a sort of "electronic baby-tender"; you plug the transmitter in the nursery, connect the receiver in a friend's home where you are spending the evening, and scoot for home if and when you hear your child call.

The theory of operation, and the construction of a carrier-current transmitter, were described in an earlier installment (see P.S.M. for February 1945, pp. 192-194). Worth emphasizing again, however, are certain cautions that hedge the wartime use of even this limited form of communication:

1. Since in certain strategic areas Gov-



ernment rules prohibit all unlicensed communication, check up first to make sure that you do not live in such a locality. Your local War Emergency Radio Service will be able to tell you.

2. *Don't* connect your transmitter to an aerial. This form of activity, like photographing new battleships and burglarizing arsenals, is apt to bring a vigorous response from the authorities.

3. Limit the transmitter output to 10 watts or less, and keep the frequency between 150 and 200 kc. Higher frequencies may radiate, while lower ones are needed by power engineers for their own messages.

4. If you plan to use your carrier-current equipment between your house and a specific friend's, check to make certain that both houses are fed by the same power-distribution transformer. The reason is that limited output power may not suffice to push the signal past the choking effect of such a transformer.

The receiver circuit, shown on page 194, is basically that of a T.R.F. receiver. It is similar to conventional broadcast receivers of this type, save that it has fixed tuning. Since you are interested in receiving only one station—your own transmitter—you can dispense with the complexity of tuning condensers. A second advantage of fixed tuning is that you can, with a simple modification, use standard 175-kc. intermediate-frequency transformers to serve as ready-made, neatly packaged, and highly efficient tuned circuits.

The one modification is made in the primary of the input transformer (the one connected to the grid of the 6SK7). The conventional way of connecting these transformers is to use parallel tuned circuits, as in diagram A; but because you will hitch one primary onto a power line, not another vacuum tube, you will need a series tuned circuit. The standard color code of the Radio Manufacturer's Association calls for red and blue leads to the primary of I.F. transformers, and green and black leads to the secondary. As you get the transformer from a radio-supply store, the circuit

will be that of diagram A; take the coil out of its can and change its connections to those in diagram B. Keep the red lead attached to the same coil lead, because the orientation of the coils makes a difference. It's a good plan to install some sort of lug to which to solder the fine coil wire so that it won't get broken by handling of the red lead after the coil is back in its can.

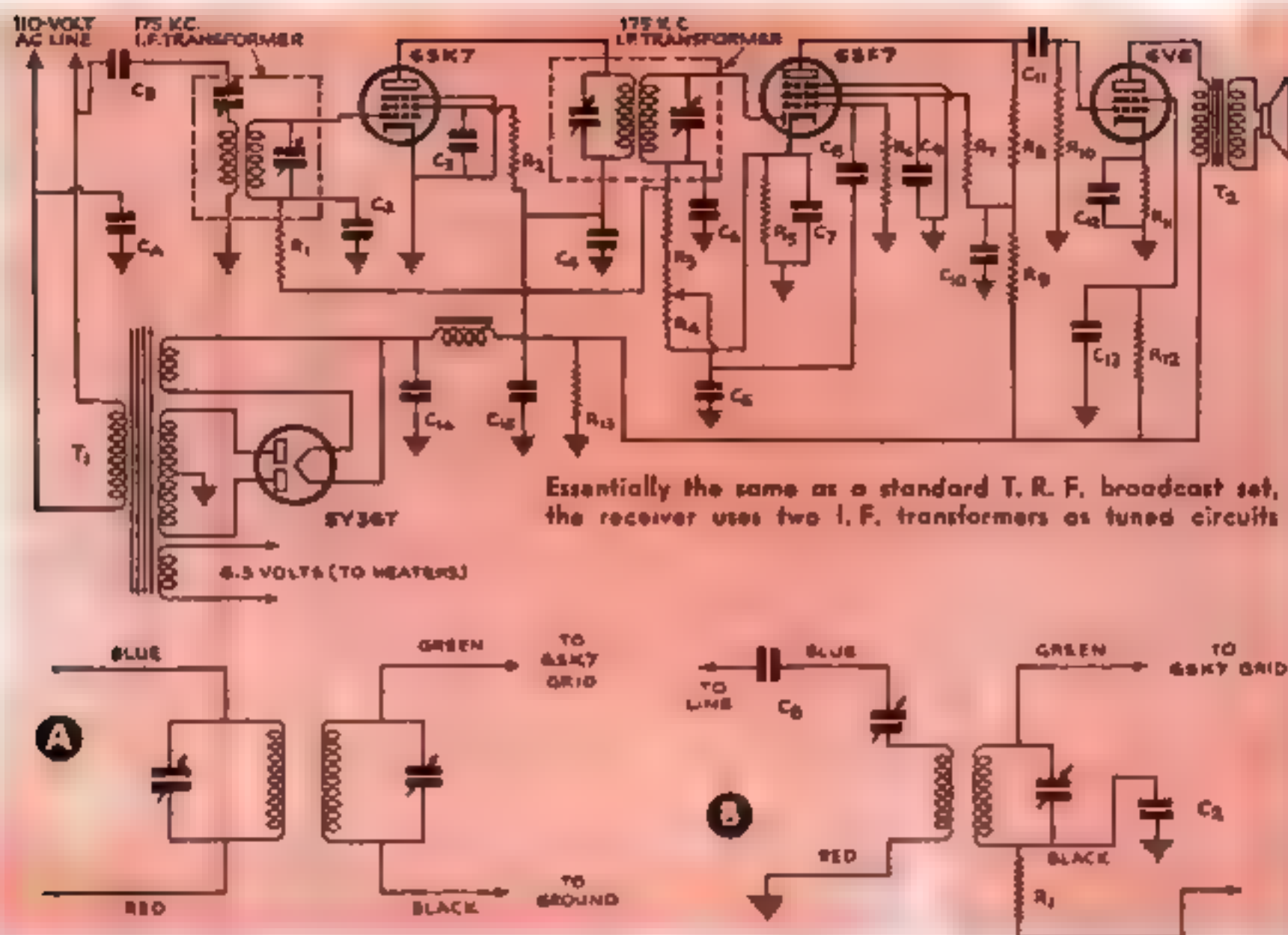
Other tubes than those called for in the circuit diagram may naturally be used. For the power tube, any tetrode, pentode, or beam power tube may be made to do, though with varying rates of gain. A 6K7 or other remote-cutoff pentode can replace the 6SK7. A 6SQ7, 6Q7, or other diode-triode tube can replace the 6SF7, provided that another triode or pentode amplifier stage is added to make up for the lower gain.

Aligning the receiver and tuning the transmitter to it is fairly simple. Essentially, the procedure consists of using the transmitter as a test-signal generator while aligning the tuned circuits in the receiver. To do this, you will need to impress an audio-frequency signal on the transmitter output; one simple way is to run a temporary jumper from the grid of the audio power tube in the transmitter—the 6L6—to the ungrounded side of the 6.3-volt heater line, thereby putting a 60-cycle hum signal on the transmitter.

Disconnect the coupling condensers

Plugged into an outlet in a neighboring house, this neatly boxed receiver faithfully reproduces any sounds that are picked up in the nursery at home





A standard 175 kc. I. F. transformer will be found to be connected in two parallel circuits, as above

from the transmitter output secondary to the 110-volt line, and leave them off until aligning is complete. Temporarily ground one end of the output secondary, and run a test lead from its ungrounded end out to the plate of the 6SK7 in the receiver through a condenser of about 500 mmfd.

The signal should be amply strong enough to drive through substantial mistuning of the transmitter and receiver. It may be that the transmitter is tuned to a frequency beyond the range of the receiver transformer; in that case, try exploring with the trimmer in the transmitter oscillator circuit so as to bring the frequency into the range covered by I.F. coil adjustments. Adjust the trimmer of the second I.F. transformer to give maximum volume.

Next, move the test lead from the 6SK7 plate back to the coil side of C_6 , and retune the trimmers on both I.F. transformers for maximum output. Finally, remove the test lead entirely and sharpen the tuning.

With the receiver now tuned, place it as far from the transmitter as you can and still hear the hum from the receiver speaker, and adjust the trimmers on the 6V6 plate tank circuit in the transmitter. If you wish to accentuate the reception for tuning, try hanging about 4' of wire from the un-

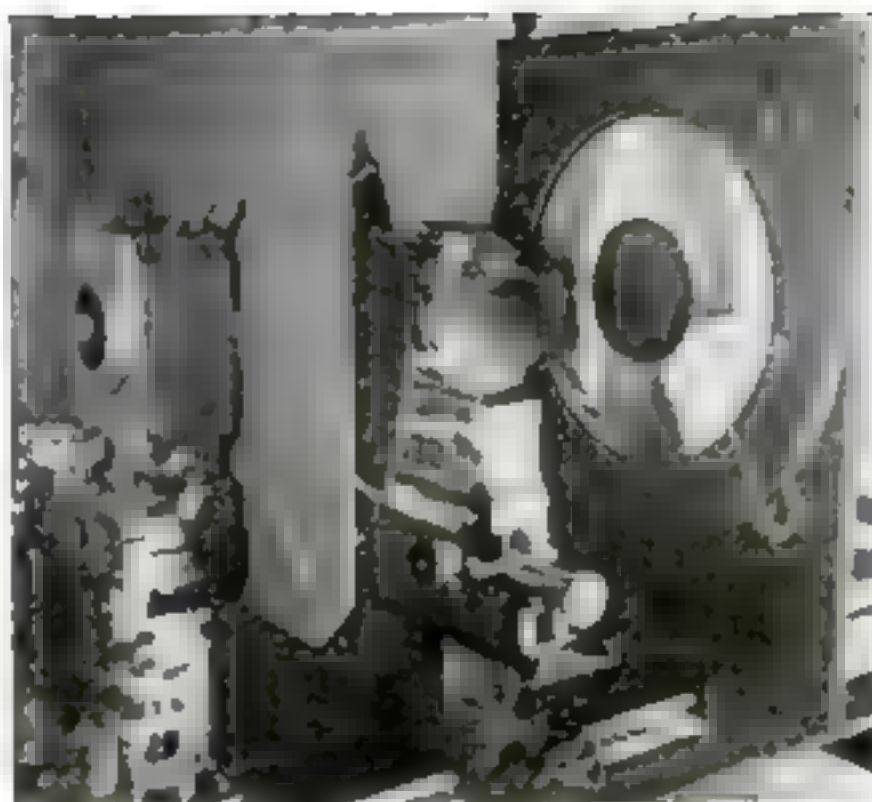
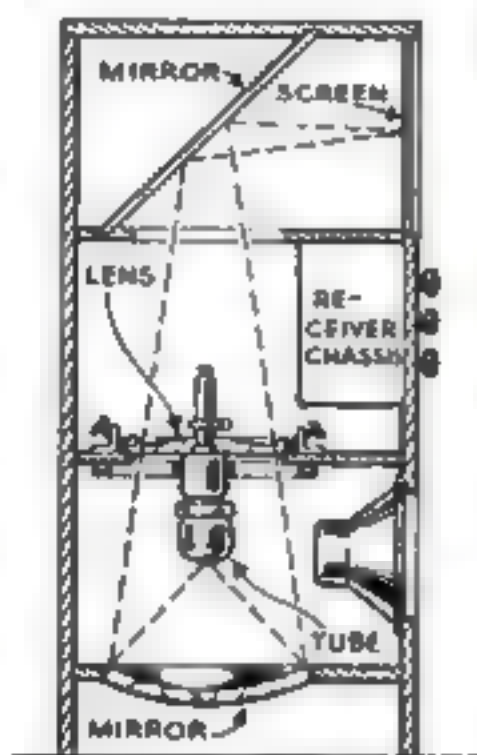
The first (input) transformer must be taken apart and rewired with its primary in series, like this

grounded end of the secondary in the transmitter, wrapping it loosely around the lead that carries power to the transmitter. Then trim the tank circuit to give maximum volume in the receiver, remove all temporary connections, replace the permanent ones, and you're done.—JOHN W. CAMPBELL, JR.

KEY TO RECEIVER PARTS

C_A, C_B :	.002 mfd., 600 volt, mica
$C_2, C_3, C_4, C_5, C_{12}$:	.1 mfd., 400 volt
C_6, C_7 :	250 mmfd., mica
C_7, C_{12} :	20 mfd., 25 volt, electrolytic
C_{10} :	.25 mfd., 400 volt
C_{14}, C_{15} :	10 mfd., 450 volt
R_1 :	2 megohms, $\frac{1}{2}$ watt
R_2 :	250,000 ohms, $\frac{1}{2}$ watt
R_3, R_4, R_5 :	500,000 ohms, $\frac{1}{2}$ watt
R_4 :	500,000-ohm potentiometer, $\frac{1}{2}$ watt
R_6, R_{11} :	300 ohms, $\frac{1}{2}$ watt
R_7 :	1 megohm, $\frac{1}{2}$ watt
R_8 :	100,000 ohms, $\frac{1}{2}$ watt
R_{10} :	500,000 ohms, $\frac{1}{2}$ watt
R_{12} :	40,000 ohms, 1 watt
R_{13} :	25,000 ohms, 10 watt
T_1 :	70 milliamp. power transformer
T_2 :	8,000-ohm output transformer

radio ideas



This television-projection optical system gathers sufficient light to show a bright image on the lens even in daylight. Left, molding a lens; center, compact cabinet unit

TELEVISION PROJECTION of images of a size to suit the room or auditorium in which they are viewed is possible with a reflective optical system developed by RCA. The principle has long been used in astronomical telescopes, but RCA experts in optics, electronics, and mechanical engineering were required to adapt it to short-throw projection and also to cheapen the cost to make it practical for television sets.

Special mirrors and a special lens are employed. A mirror with a concave spherical

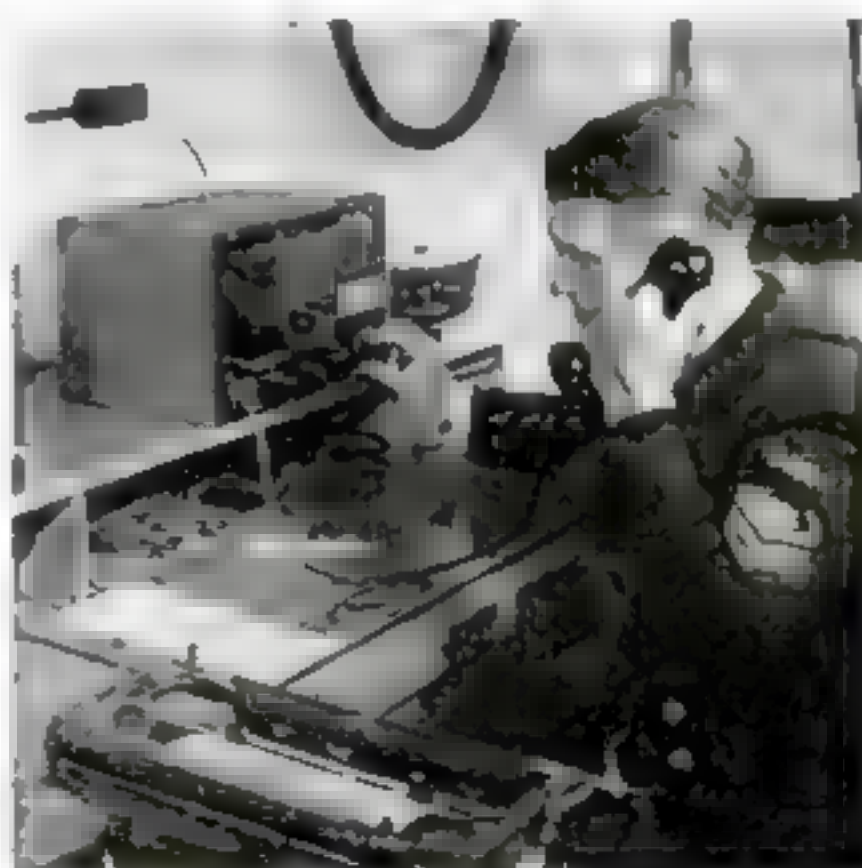
surface takes the image from the television receiving tube and transmits it through a correcting lens to a flat mirror which projects it onto the screen.

One surface of the lens is flat while the other rises slightly at the center and edge from a depressed intermediate area. This makes it optically positive in the center and negative in the outer portions. To reduce the cost, a transparent material was found for molding the lenses on optically finished metal surfaces.

One compact television unit has the projection system mounted vertically in the cabinet, as shown in the drawing. The image is projected on a built-in screen.

YACHTSMEN'S TELEPHONES—8-watt radio transmitter-receivers that formerly kept small boats in touch with land telephones and with other vessels—are now being used on Merchant Marine wartime cargo ships. A midsize Western Electric ship-to-shore phone is shown in the photo at right in use on a Merchant Marine training vessel.

COMPLETE RADIO-TOOL KITS in portable size are issued by the U. S. Air Service Command's Supply Division to communications men at bomber and fighter stations in England for repair work on aircraft radios. Among the tools are a full set of socket wrenches, a drill motor and drills, soldering irons, assorted pliers, hammers, screwdrivers, open-end and adjustable wrenches, files, and a hacksaw.



HOME EXPERIMENTS WITH



EACH MOLECULE in magnetic material is itself a tiny magnet, according to the generally accepted theory. Ordinarily these molecules are arranged haphazardly, and the material has no definite polarity. When iron or steel is magnetized, however, the molecules are lined up in the same direction, and the ends exhibit both attraction and re-



pulsion for another magnet. Heat destroys magnetism because it loosens the bonds that hold the molecules together.

Magnetize a needle by stroking it on a permanent magnet, and it attracts one end of a compass needle and repels the other. Heat it red hot, and it attracts the compass feebly, if at all, and both ends behave alike.



MAGNETIZED IRON FILINGS illustrate the molecular theory of magnetism in another way. Fill a glass or paper tube nearly full of filings and, taking care not to shake the filings, magnetize them by stroking them over a permanent magnet. Tested with the compass, they have the same effect as the magnetized steel needle, attracting one end and repelling the other.

Now shake the tube to allow the filings to assume a haphazard arrangement. Either end of the compass needle can then be attracted feebly to either end of the tube. This is because disturbing the arrangement destroys the magnetism of the filings as heating did that of the needle.

WITH A "MAGNETIC SWING" made from copper wire bent into a U and hung loosely on copper-wire hooks, you can show how electricity and magnetism interact. Mount one pole of a bar or horseshoe magnet to project 1" or so through the "swing," as shown at the right. Touch the two leads from a dry cell to the two supporting wires, and the swing moves, the direction depending upon the connection. Reverse the connection, and it moves the other way.

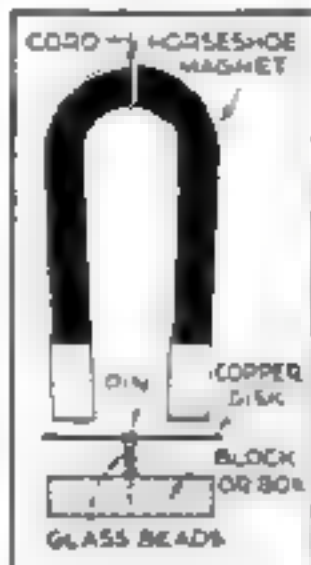
When the swing moves out, the magnetic field created by the current flowing through it is of the same polarity as that of the magnet pole; when it swings in, the field is the opposite. This principle is applied to many automatic electrical switching devices and to electric motors.



MAGNETISM

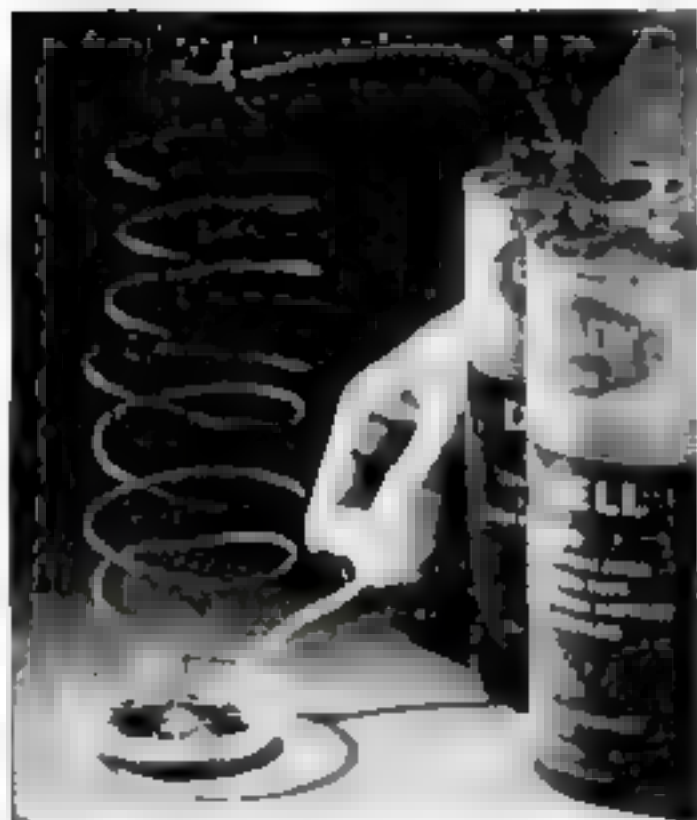
THOUGH NOT MAGNETIC, copper can be made to react to magnetism. Mount a horseshoe magnet on a 12" length of string so it can be spun by twisting the cord, and under it mount a copper disk to spin freely on a pivot. Adjust the length of the string so the magnet won't quite touch the disk. Then twist the string a dozen times and release it. As the spinning magnet gains speed and gets closer to the copper disk, the disk begins to rotate.

Although the copper itself does not become magnetic, a magnetic field is set up around it by eddy currents induced by the revolving magnet. This reacts with the magnetism of the horseshoe to produce motion. The same principle is employed in household electric meters, with eddy currents produced by the A.C. itself.



THIS DANCING COPPER COIL demonstrates an odd trick of electromagnetism. Many who are aware that magnetic materials are drawn into a coil through which an electric current flows don't know that the turns of the coil tend to draw closer together at the same time because of magnetic attraction. Wind a loose coil 2" or so in diameter of a dozen turns of fine copper wire. Suspend one end from a stiff wire leading from one terminal of a dry cell and have the tip of the other end barely touching a little mercury in a dish.

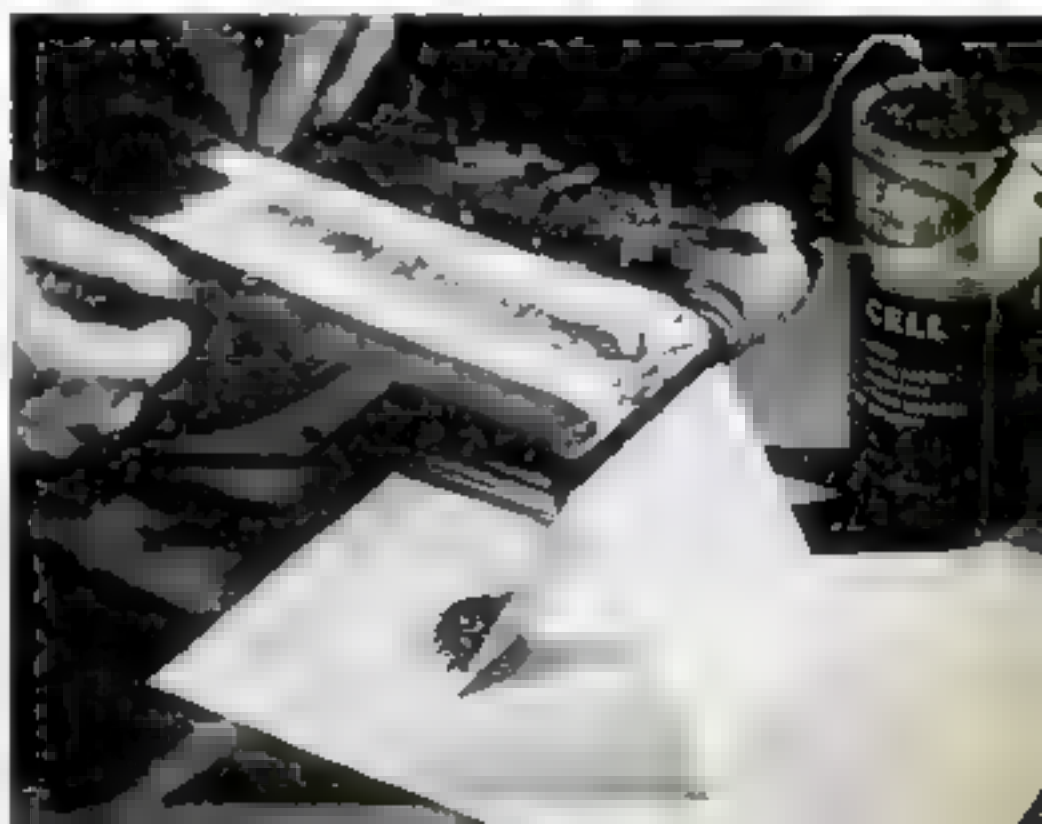
Touch a wire leading from the other terminal of the dry cell to the mercury, and the coil immediately contracts because of the magnetic attraction between the turns, and in doing so it breaks the electrical circuit. When this happens, the coil spreads out again, the tip makes contact with the mercury, and the circuit is remade. This again causes the coil to contract, again breaking the circuit, and the process is repeated. The effect is best if the turns are rather close together.



MAGNETIC SEPARATION, known in many manufacturing plants where iron bolts and other parts must be separated from non-magnetic metals, can be shown with a model that makes a fascinating toy. Wind 100 turns of bell wire around half the length of a bolt about 6" long. Then make a continuous-belt carrier of paper, slipping one end over the other half of the bolt, which is left bare or covered with a glass tube to help the belt to turn. The other end of the belt may turn on a dowel or another glass tube. Motive power can be simply by hand or by any arrangement desired. Install a tent-shaped separator made of paper as shown.

Connect the ends of the bell wire to the terminals of a dry cell—one cell provides sufficient current—and drop sand and iron filings on the belt as it slowly turns. As they

reach the end at the magnet, the sand falls off immediately on the far side of the separator, while the filings stick until they reach the other.





Mirrors are silvered with a solution of silver nitrate to which first ammonium hydroxide and then potassium hydroxide are added in drops

By KENNETH M. SWEZEY

OF THE precious metals, gold, silver, and platinum, silver is both the most common and the most useful. Beauty, malleability, sonorousness, and resistance to atmospheric oxygen have put it in demand for coins, jewelry, tableware, ornaments, and bells since the beginning of history. Because it has the highest electric conductivity of any substance, it is prized in electric equipment. Silver nitrate, its most common salt, is used in making indelible ink and hair dyes, in photography and silver plating, and in medicine as an antiseptic and germicide taken both internally and externally.

The metal is found both in its native state and as a salt. Its chemical symbol Ag is derived from its Latin name *argentum*. The familiar sterling silver is solid silver alloyed with 7.5 percent copper to give it hardness. United States coins are a similar alloy of 10 percent copper. Plate is silver coated on a cheaper and harder metal such as steel or brass.

Because silver is the most highly reflecting of all the metals, most mirrors are coated with it. Minute particles of metallic silver, separated from a solution of silver nitrate by the addition of a reducing agent, are deposited on the glass. You can demonstrate the technique by silvering the inside of a small flask. After you have acquired

Silver

. . . most useful precious metal,
it is prized for coins, jewelry,
plate, photography, and medicine.

To silver a flask like that shown below, pour the ammoniacal silver solution into it and add a reducing solution. This changes the compound into finely divided metallic silver that is deposited on the glass



experience, you can silver telescope mirrors and ornamental glass objects. Use a porcelain, enameled, or paraffin-coated tray as a container.

The reducing solution must "age," so it should be made several days or even weeks in advance. Make it by dissolving 22 grams cane sugar in 250 ml. water in which has been mixed 45 ml. ethyl alcohol and 1 ml. concentrated nitric acid.

Do not make up the silvering solution until just before using for, although it is safe while fresh, it becomes concentrated when it stands and forms silver fulminates—sensitive chemicals that may explode at the slightest touch. Immediately after use discard the remaining solution by washing it down the drain with plenty of water.

This silvering solution is mixed in a large beaker or in an Erlenmeyer flask. For a first-rate silvering job, use only distilled water. Dissolve 5 grams silver nitrate in 75 ml. water, and add slowly with constant stirring some concentrated ammonium hydroxide. A dark-brown precipitate of silver oxide will form first, but it will dissolve as more ammonium hydroxide is added. When the solution begins to clear, put the ammonium hydroxide in drop by drop until it is completely clear.

Now add very slowly and with constant stirring a solution made up of 2 grams potassium hydroxide in 80 ml. water. Silver oxide will again be precipitated, and it again will begin to clear with the addition of more hydroxide. Stop adding the potassium hydroxide, however, while the solution is still a light brown, disregarding any suspended matter that may be present.

Clean the flask to be silvered with alcohol or ether and follow with a swabbing of nitric acid applied with cotton on the end of a glass rod. Rinse the nitric acid off

with distilled water. Then immediately half fill the flask with the silvering solution and add the reducing solution until it is full, swirling the flask to mix the two. The temperature of both solutions should be about 18 deg. C. (64 deg. F.). Keep swirling the flask gently, and in a few seconds bright silver will appear on the inside surface. This coating should be sufficiently thick in about five minutes, after which the flask should be emptied down the drain and rinsed out to prevent forming of a fulminate. A coat of varnish or shellac will keep the silvered surface from tarnishing.

Although silver does not react directly with oxygen, it tarnishes by reacting with sulphur such as is contained in rubber bands (vulcanized with sulphur), eggs, and mayonnaise. Traces of hydrogen sulphide in the air also cause the black coating that requires frequent polishing.

To show the nature of tarnish, you can produce it quickly by exposing a silver object to hydrogen sulphide gas. Cover a few grains of iron sulphide in a small vial with dilute hydrochloric acid, place the vial in a tumbler, and put beside it a silver spoon that has been moistened with water. Cap the tumbler loosely and stand it outdoors or in a well-ventilated room, for the gas has a foul odor and is poisonous.

Most people remove the tarnish from silver by rubbing with a soft abrasive such as infusorial earth or precipitated chalk. An electrolytic method requiring no manual effort is also known to housewives. The silverware is placed in a clean aluminum pan, with each piece touching the aluminum, and is covered with water containing several teaspoonfuls of washing soda (sodium carbonate). To hasten the reaction, the water is heated almost to boiling. The silver, touching the aluminum and surrounded by sodium

Tarnish is removed from silver electrolytically with an aluminum pan and washing soda. To show tarnish is a sulphide, generate some hydrogen sulphide in a lightly covered tumbler containing a piece of silver





Black silver nitrate stains can be removed from cloth by copper chloride, hypo, and a water rinse

carbonate solution, forms one plate of an electric cell which first turns the silver sulphide tarnish into metallic silver and then deposits this on the pan. Steel wool easily removes discoloration from the pan.

This electrolytic method does not wear the silver away any quicker than abrasive rubbing. It should not be used on silverware having a "French finish," that, is, a finish in which the depressions are toned with gray, since it may clean out the depressions as well as the surface.

Silver nitrate (AgNO_3) is formed by dissolving silver in dilute nitric acid. In its pure form it is a white crystalline substance that readily dissolves in water. It is a strong oxidizing agent and will burn the skin, leaving a black stain of finely divided metallic silver. Silver nitrate stains on cloth may be removed by treatment with a 20-percent solution of copper chloride, then with a 10-percent solution of sodium thiosulphate (photographers' hypo), and a final rinse in plain water.

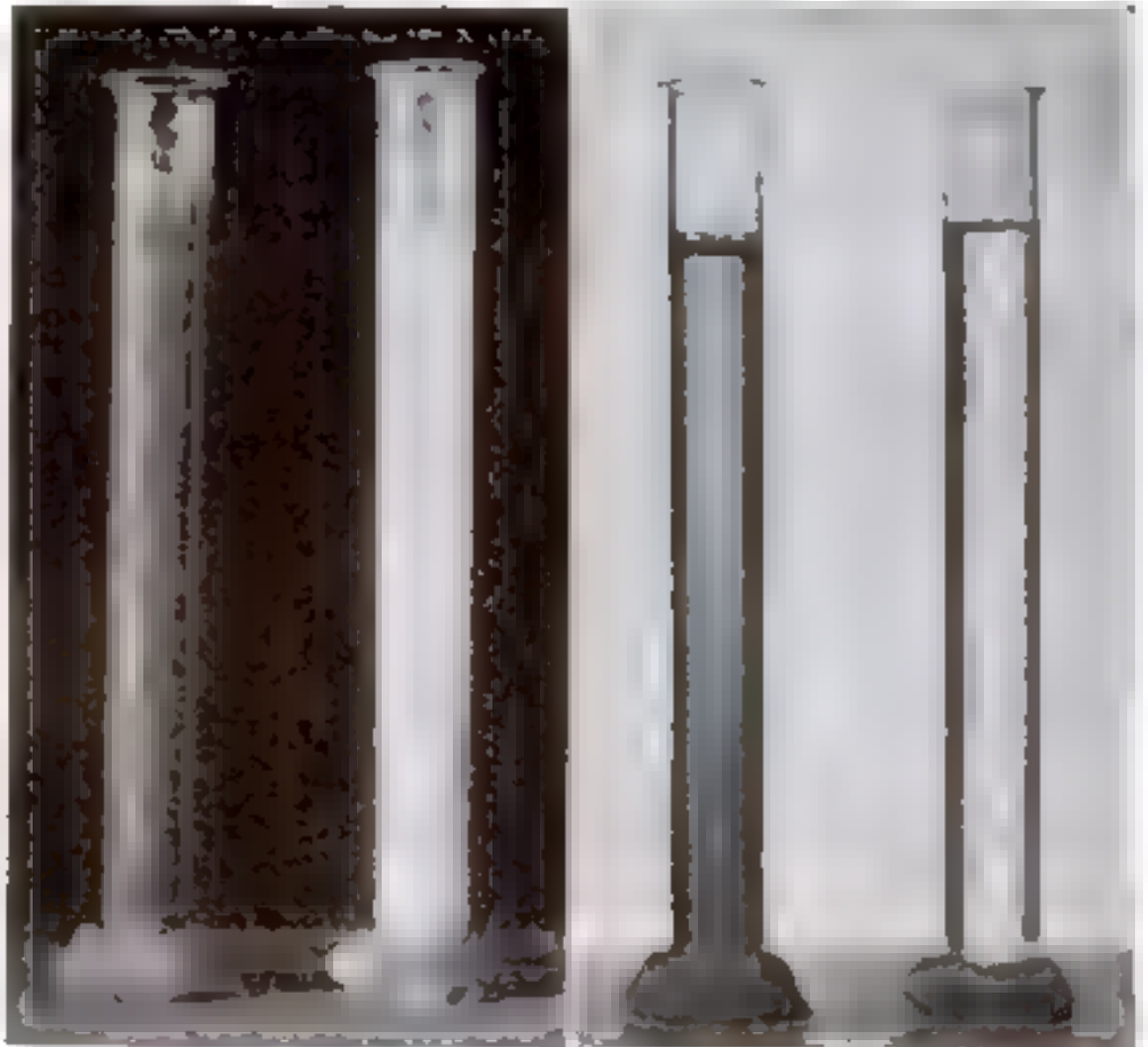
Add a solution of a soluble bromide, chloride, or iodide to a solution of silver nitrate, and

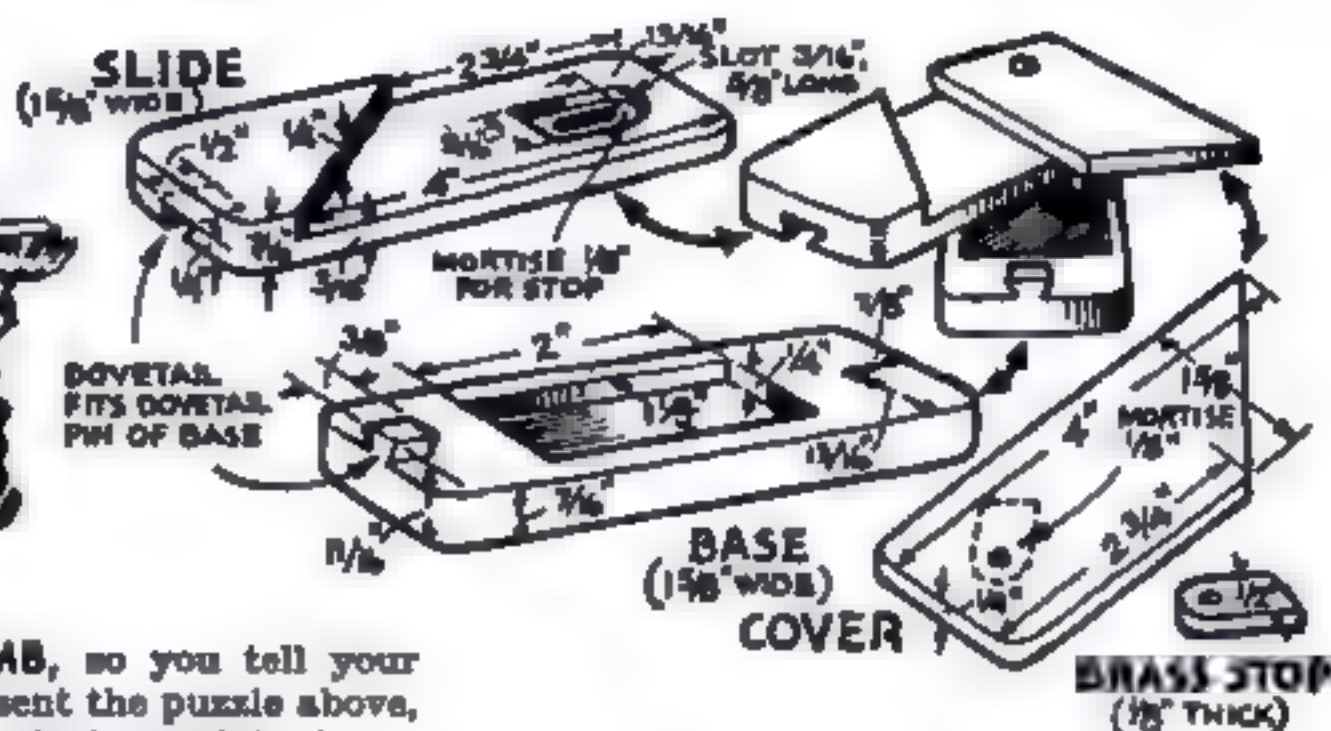
you will get a light-sensitive salt of the kind that makes possible the whole magic of modern photography. Mix the salt with gelatin, spread the suspension thus made on a photographic plate or film, place this in a camera, expose it to the light through the lens, and the salt mysteriously changes. Examined under a safe light, the plate shows nothing unusual: but put it in a reducing or "developing" solution, and it is darkened by black metallic silver in density exactly proportional to the light that struck it.

The action of light-sensitive silver salts in photography can be demonstrated. Working under a red safe light, dissolve 1 gram silver nitrate in 30 ml. water and 1 gram potassium iodide in another 30 ml. water. Put 10 drops of each solution in each of two test tubes half filled with plain water and add a little standard photographic developer. You will have a whitish precipitate in the tubes. Take one tube into the light, and this precipitate will quickly turn black, the silver iodide changing into metallic silver under the influence of the light and the developer.

Again working under the safe light, complete the photographic process by adding a concentrated solution of hypo to both tubes, shake them for a minute or two so the "fixer" will dissolve the iodide that has not been acted upon by light and prevent its later conversion into black silver. The solution that was not exposed clears up completely, while the other becomes clear except for the settling metallic silver.

Here's how film works. Make two solutions of silver iodide and developer. Expose one to light to turn its precipitate black, as at left. Hypo clears both except for silver in the exposed tube



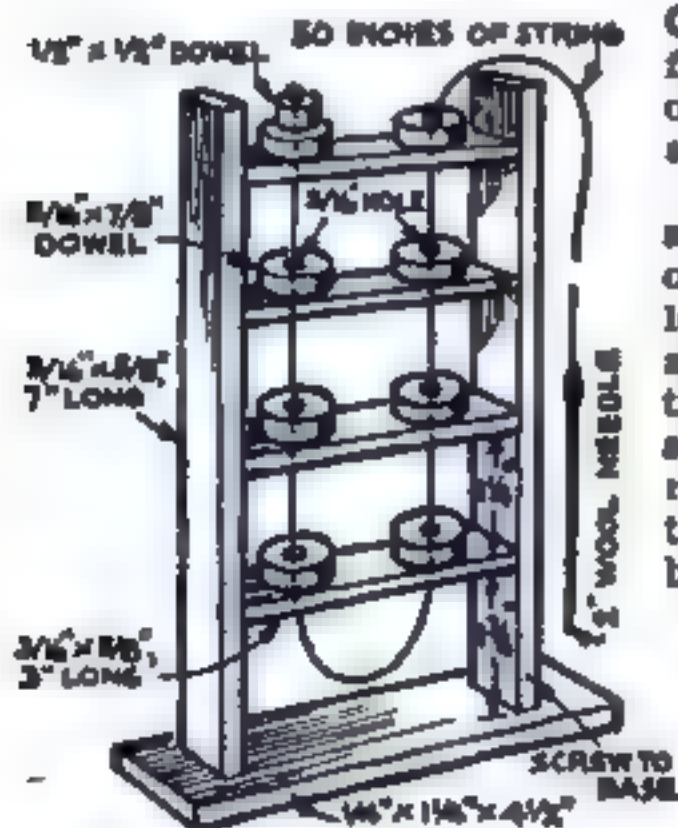


KING TUT'S TOMB, so you tell your friends as you present the puzzle above, was protected against vandals by a trick device like this. The chances are that most of your friends who try to open the little puzzle will have many a moment of frustration before they learn the secret.

Building details are given in the drawing above for the four parts—base, slide, cover, and brass stop. They are easy to make, but must be accurate. The stop fits into the depression in the slide and locks the box once the slide

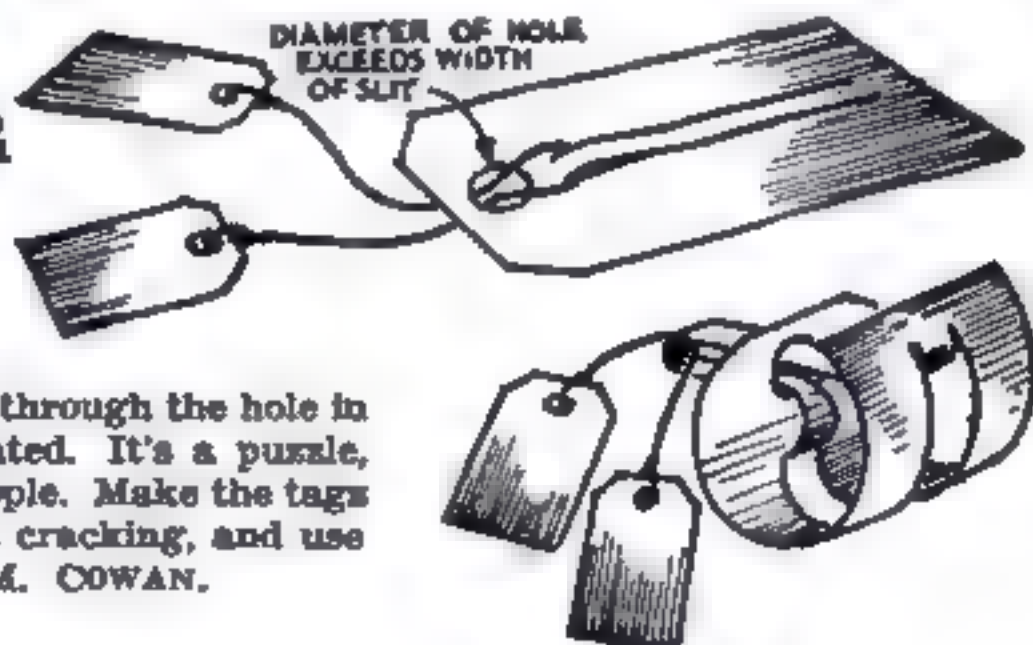
and cover are in place. To open the box, merely turn the puzzle over, swing the cover out the proper amount, and let the stop fall into its depression. The slide can then be pulled back since its pivot hole is in reality a slot.

Use hardwood so the pieces won't wear, and finish with a stain and varnish. The dovetail can be glued into the base to avoid carving both from one piece.—GEORGE BARR.



CAN YOU REMOVE the eight wooden washers from the ladder shown at left without taking them off the string? This is an ancient Chinese puzzle, and it is still a teaser.

Thread the needle back through the washers and the holes in the rungs, beginning at the one on the top right in the drawing and keeping a loop above this washer so it is never really off the string. Now, thread the string through again, this time beginning at the upper left and taking the string through the washers but not through the rungs. All that then remains to be done is to draw the loop at the upper right through, and they will be off the ladder and on the string.—G. B.



THREE TAGS held together with a cord, as shown at right, can be separated easily by folding the slit portion through the hole in the large tag in the way indicated. It's a puzzle, though, that will fool a lot of people. Make the tags of cardboard that bends without cracking, and use reinforcement rings.—ROBERT M. COWAN.

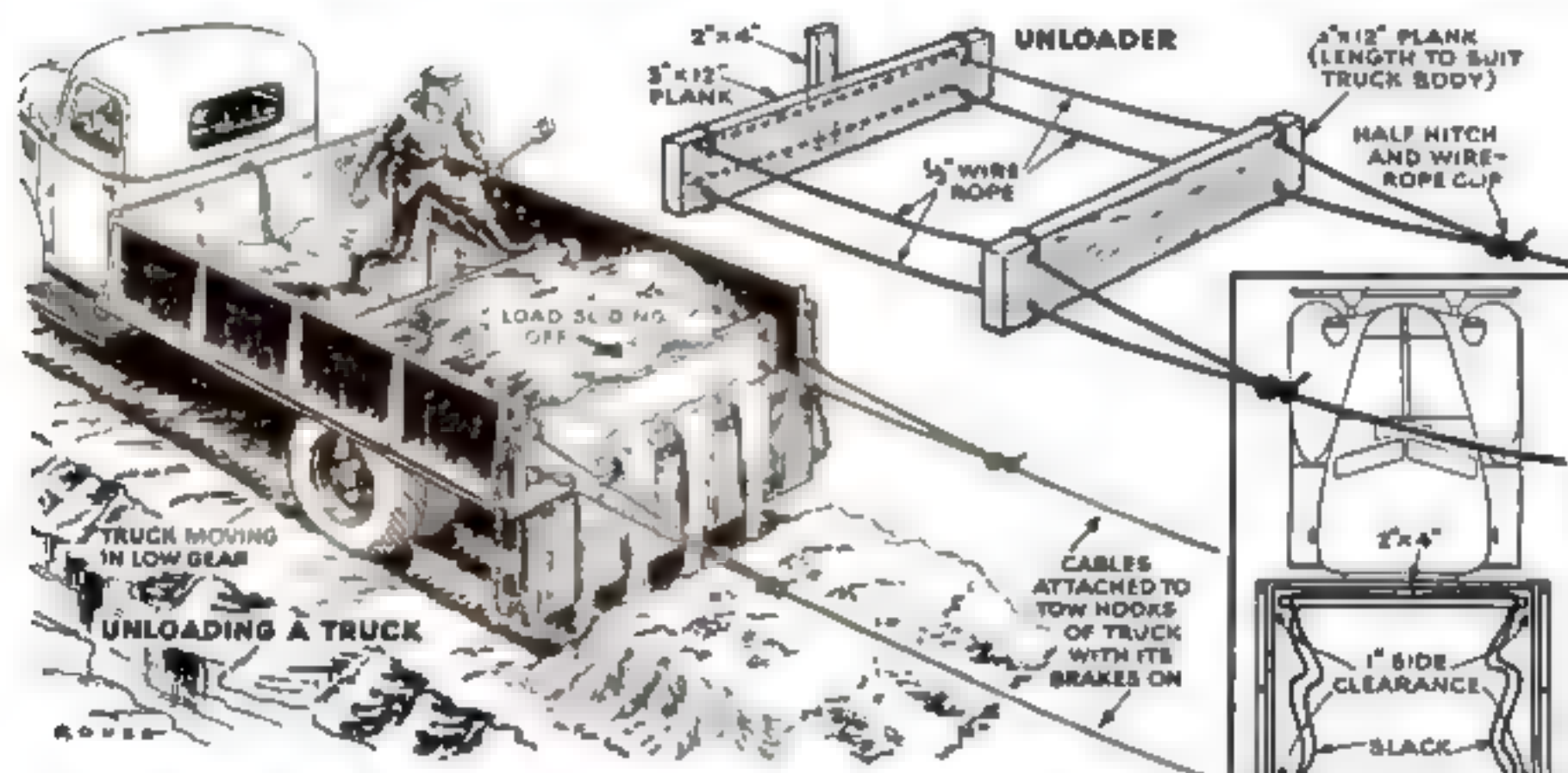
Roadside Stand Made as Two-Wheeled Cart

THE farmer or other country dweller whose land sometimes produces a profusion of fruit or vegetables frequently finds that a roadside stand is a simple and profitable venture. Most stands, however, must be permanently placed, remaining out in full view in seasons when they are of no use. The stand shown can not only be trundled out of sight when not needed, but also has the asset of an unusual and attractive appearance. It may consist of the wheels and axles of an old buggy or surrey, fitted with a simple 4' by 7' box body. Prop legs, a frame for



the awning, and a pole handle complete the essential parts. Paint the wagon stand a gleaming white and set it off with an awning of pleasing maple green for an attractive contrast.—BRUCE MACINTOSH.

Wire and Planks Serve as Unloader of Gravel or Coal in Truck



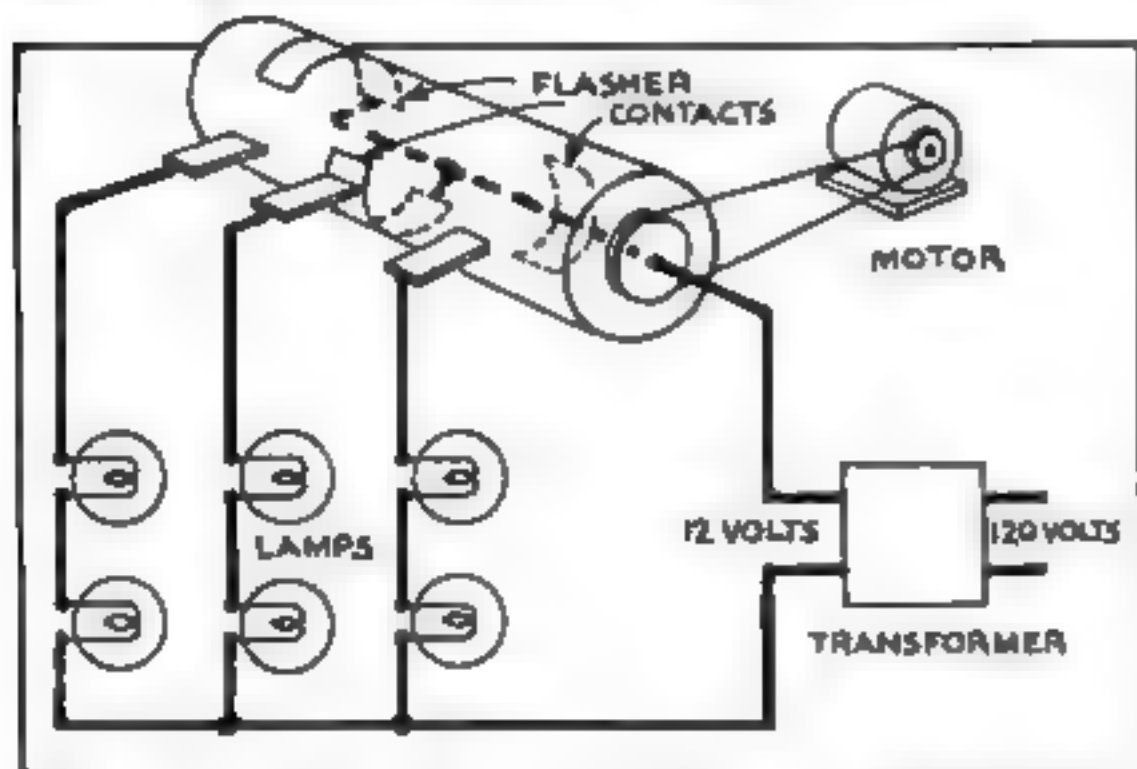
Two planks and two lengths of $\frac{1}{2}$ " wire rope may be fashioned into a simple unloading device that permits the use of cargo trucks as dump trucks, and that allows a load of gravel, coal, or the like to be unloaded in jigtime. The idea, as reported in *Army Motors*, was devised overseas by Captain D. M. Googins, a member of the 184th AAA Gun Bn.

The unloader is constructed as shown in the drawing above, allowing about 1" side clearance between the plank ends and the truck body. The forward plank is fitted with a short vertical two-by-four that can be chained to hold the plank upright while the truck is being loaded.

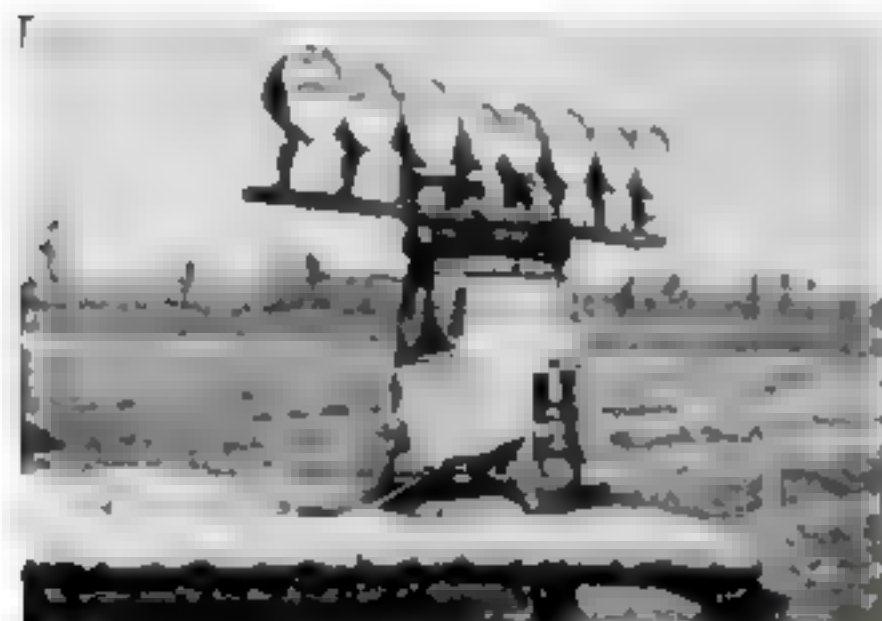
If a power shovel is used for loading, the

first shovelful must be dropped carefully so that the rear plank won't be knocked over. The latter plank should be located a bit forward of the center of the truck body; a little slack in the cables between the two planks allows the rear load to be dumped separately. Hook the cables to another truck with the brakes set, a convenient tree, or some other suitably solid object. During the unloading process, which consists merely of driving the truck slowly ahead, the truck floor will be scraped clean if one or two men "ride" the rear plank.

Rotating Lights Scare Ducks Away from Newly Planted Fields



Rotating the lights themselves isn't necessary with the flasher circuit shown above, for the lamps are energized in sequence. The original model, pictured below, uses a junked washing machine to turn them



WIDGEONS were a tough problem for farmer Joe McMillan of La Conner, Wash., and none of the classic methods of widgeon assault—beating dishpans, waving red flares, shooting off firecrackers, and even potting a few with shotguns—seemed effective to him. For the widgeons, a breed of duck with a fondness for seeded fields, would merely retreat in the darkness until the rumpus ceased and then swoop back to feast on his newly planted

The clue that started Mr. McMillan on the road to a solution of his widgeon problem was the discovery that one part of his land was left severely alone by the foraging ducks. This part was near a curved highway, and auto headlights swept over it as they made the turn. His solution, evolved with the aid of Eugene Schuh and Charles Wildebour of the local utility company, was to build a widgeon-frightener: a revolving light improvised from eight headlights mounted on an old washing machine.

So thoroughly did this gadget alarm widgeons that Mr. McMillan's fame spread; lately the Government's Fish and Wildlife Service has come out with plans for a simplified duck-scarer, shown schematically at left above. In this design the lights themselves do not revolve, but are lighted in sequence by a flasher that gives the illusion (to widgeons) of rotation.—E. M. BERNARD

A BEAM 2,500' LONG is produced by this portable and rechargeable searchlight, according to its makers, the U-C Lite Manufacturing Co. of Chicago. It's powered by

a 6-volt storage battery that can be recharged without removal from its container by an A.C. rectifier, a home-lighting plant, or other D.C. source. The lamp head may be turned in any direction and the unit is well balanced for carrying on a shoulder strap or by hand. A snap-on lens gives a floodlight effect.

TESTING ELECTRIC FENCES has commonly been done with devices that simply showed the presence or absence of a potential on the section being checked. The tester in the photo below will indicate if current is being drawn off by weeds, branches, or cracked insulators to an extent that might render the fence ineffective in the control of livestock, according to the Prime Manufacturing Company, of Milwaukee, Wis.





Shades Tailored to Fit Each Window



COLORFUL figured or plain satiny oilcloth can be made up in your own home into durable, washable window shades. Patterns are available to carry out the decorative scheme of a kitchen or bathroom, while for other rooms there are handsome felt-backed oilcloths in white or cream with stain-finished brocade designs. Old rollers may be used if the springs are still good, or you may purchase new rollers of the desired width at a hardware or department store.

Cut the oilcloth $\frac{1}{4}$ " narrower than the roller and 12" longer than the window. At the bottom turn up a plain hem with the longest stitch on your sewing machine or attach a scalloped border, as shown in the

drawing. In either case leave a pocket for a stick to hold the end flat. Then lay the oilcloth on the floor or a table and tack the upper end to the roller, using $\frac{1}{4}$ " tacks so as not to damage the spring and checking to see that the finished side will be toward the room. Oilcloth usually comes very wide, and for kitchen and bathroom windows it may be possible to save material by using the width for the length of the shade if the pattern is such as can be turned sideways.

Handsome, serviceable shades for porches and playrooms can be made in the same way with fine matting. If you can obtain the proper widths, all you need do is tack it to rollers; otherwise you must cut it and bind the edges.—ELIZABETH KETCHAM.

Miter-Gauge Rod Serves as Auxiliary Fence on Circular Saw

For cutting duplicate pieces to identical length with the miter gauge, the rip fence is often used as a stop gauge, but pieces so cut off tend to wedge between the blade and the fence. Separate attachments are available, or a makeshift arrangement can be set up by holding a piece of wood against the fence with a C-clamp. However, the purpose can be served admirably by using the miter-gauge rod as shown.

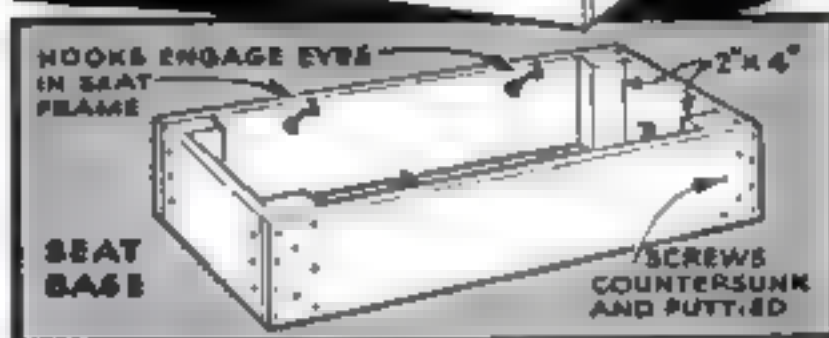
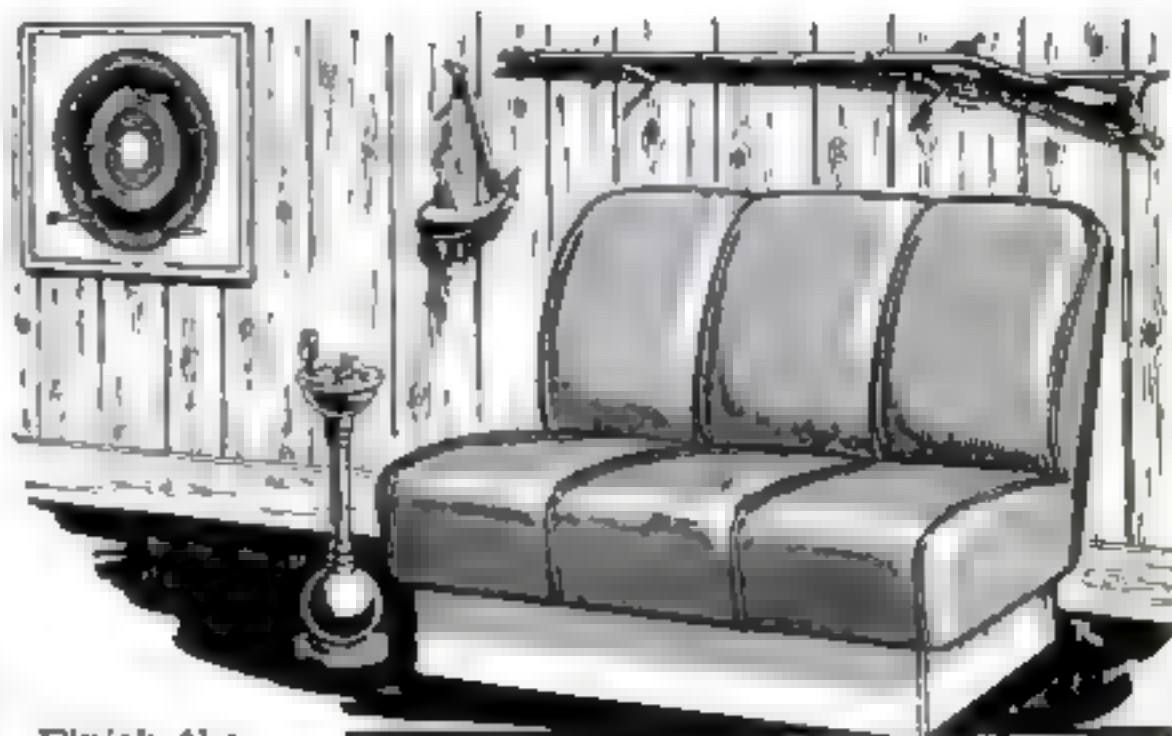
In the rip fence, well in front of the saw blade, drill a hole for

a sliding fit for the miter-gauge rod. Then, directly above this hole, drill and tap a second hole for a thumbscrew to tighten on the rod. Work is set up to the rod while held against the miter gauge, but is clear of the stop when cut off.—BURL KNUTSON.



Base Added to Station-Wagon Seat for Use in a Recreation Room

IF YOU are planning to hold a large party in your basement recreation room, you probably will need extra seating facilities. You can use the leather seats from a station wagon for the purpose simply by adding temporary wooden bases to them. Make each base, as shown in the accompanying drawing, from four boards and four 2" by 4" corner posts. For a modern effect, make the base shorter and narrower than the seat. The over-all height of the seat and base should be 15" to 18". Finish the base by countersinking and puttying all fastenings, sanding smooth, and painting with a bright-colored enamel. Attach the seat with hooks and eyes to anchor it for use of your guests. Then, after the party, put the seat back in the car and store the base for future use.—ROBERT M. FLETCHER.



GROWTH-REGULATING SUBSTANCES for use as selective herbicides—that is, for killing one plant while leaving another in perfect health—have been examined by two scientists, C. L. Hamner and J. W. Mitchell. Experimenting on bindweed, they discovered that one of the most potent of these compounds is 2, 4 dichlorophenoxyacetic acid. In the photo at the right, the area shown at the left of the dividing line was treated with the acid. That to the right was untreated. Mr. Hamner asserts

TAKING THE JOLT out of tractor riding is the special feat of this new suspension seat, developed and manufactured by the Monroe Auto Equipment Company, of Monroe, Mich. Ever since that spine-jolter, the tractor, was first introduced, farmers have been far from comfortable while operating it. In this seat, a special triple-action hydraulic shock absorber offers resistance to violent action on the part of the coil spring under the seat, providing a level ride for the operator when the chassis bounces up and down over the usual rough terrain traversed by tractors.

that such a treatment constitutes a new principle in weed control. The acid produces a cancer-like growth in the weed that leads to death by physiological response, not by the usual caustic action.



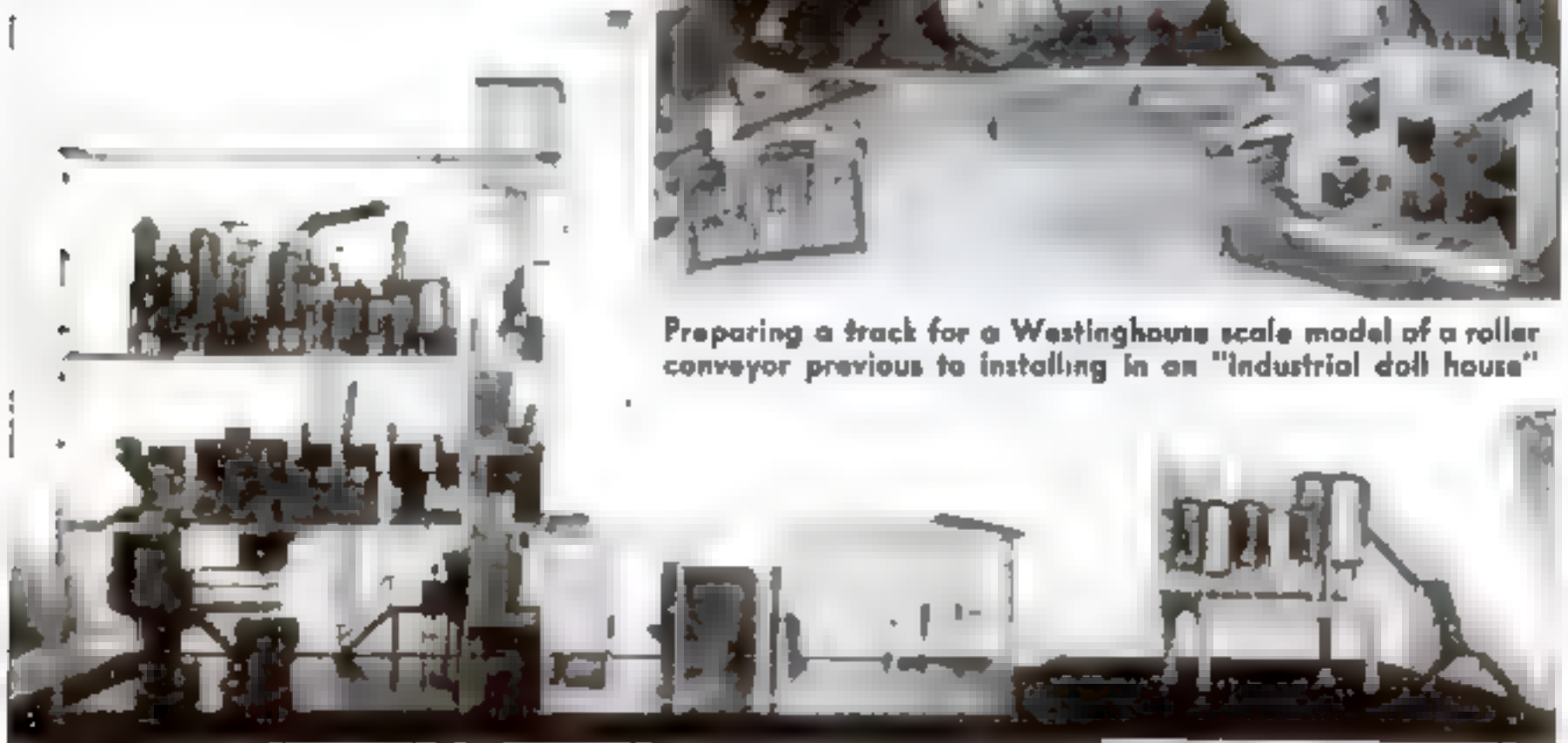


MODEL OIL DERRICK, 10½ feet tall, including base, duplicates all the important operations of the full-size rigs. Built by engineers for the Baash-Ross Tool Co., Los Angeles, Calif., it displays the operation of various tools far underground by showing them turning inside transparent plastic tubing. Insets show (at top) the ½-hp. operating motor, and (lower left) tool in its transparent plastic tube.



PLASTIC BINOCULAR CASE is made by Bakelite Corp. of low-pressure laminate. Advantages are lightness, dimensional stability at all temperatures, and resistance to moisture and fungus.

MODEL PREVIEWS of complete factory layouts have become standard with planning engineers of the Westinghouse Co. and others. Since every piece of model equipment is accurately scaled, engineers can tell the space each machine will occupy. Below is a Plexiglas-enclosed model of a synthetic-rubber factory designed by the Blaw-Knox Co. The model was made by Display Studios, of Pittsburgh.



Preparing a track for a Westinghouse scale model of a roller conveyor previous to installing in an "industrial doll house"

Japanese Land Weapons

(Continued from page 154)

guns. The Japs are smart enough to realize this situation gives them a terrific supply problem, but their lack of productive capacity in their factories evidently has made it impossible for them to correct it in time.

Before this war is over, the Japs may have their entire army supplied with the larger, improved rifle. Even so, they will still be outclassed in that category, for their newest rifle is not as good as our old Springfield—to say nothing of the Garand. They have finally achieved a muzzle velocity of 2,300 feet per second, as against 2,800 for the Springfield and Garand. Their effective range is now only 600 yards, as against our 1,000. In other words, the service rifle with which the Japs will end this war is not as good as the one with which we ended the last one.

It is much the same story throughout the whole comparative picture of war weapons. If the Japs could not copy as simple a thing as a shoulder rifle and produce one equal to the original, given all these years to do it, what chance have they to equal the extremely complicated ma-

chines with which we are fighting the war?

There are various explanations of Japanese backwardness among our experts who are well informed about the Japs and their production methods. Some think it is due primarily to a lack of engineering brains, some to a dearth of skilled mechanics, some to their limited factory capacity. It may be a combination of all these factors, and others besides. Whatever it is, the end result is the same—a hopeless tardiness in producing the weapons for fighting such a war as this, a fatal lack of adequate armor with which to meet us in the final showdown.

No doubt the Japanese war lords are aware that their finish will come quickly if and when we get into China with such force and equipment as we now have in Europe. Estimates in Washington differ widely as to how long it will take us to achieve such a landing. The Japs may be expected to stake everything upon preventing us from making a landing in force, and that includes their whole navy and all their air forces, to the last ship and plane.

World's Biggest Bargain Counter

(Continued from page 129)

overnight hikes, and are generally useful to hunters and campers, especially as they roll up into 6 by 30-inch rolls and the T bars come apart for easy packing.

The Procurement Division maintains sample rooms at its eleven regional offices in the United States and one in Puerto Rico. In its Washington showroom, for example, it is currently displaying dummy rifles suitable for cadet drill; bolo scabbards which can be converted into belt tool carriers; skis, shoes, discarded packs, a Signal Corps signaling device, various surgical instruments and appliances (some of which make excellent model-making tools), and cots and mattresses.

Already on the retail market are the first items of electrical equipment, such as compact field telephone sets of the Army Signal Corps. Each of these consists of two self-contained telephone units five by nine by 10 inches with connecting wire. The bells work on a magneto and, as the instruments are built for the most rugged service, there is hardly anything to get out of order. One department store advertises these at \$29.95.

Lanterns are available in wide variety—boat signal lanterns, circular masthead lan-

terns, and signal lanterns with swinging handles.

Of great appeal to those who need a small boat is the so-called M-1 flatbottom assault boat, constructed of quarter-inch waterproof plywood on oak frames. The over-all length is 13 feet, 8½ inches, the beam or width amidship five feet, four inches. These boats are sold to dealers with a retail ceiling price of \$75. Since the transoms are too high for outboard motors and have to be cut down for that use, dealers may add a reasonable charge for the work, as well as for supplying thwarts, oarlocks, and other accessories. The Maritime Commission has some used and re-conditioned boats for sale to individuals at a top price of \$56.

Life rafts will also be distributed by the Maritime Commission. They might be used for diving floats at lake resorts.

Very few of the items will be sold directly to the public by the Government, but department stores, mail-order houses and other retail outlets are supplied with a publication, "Surplus Reporter," which lists the items that are being released as surplus property.

Besides the Treasury Department's Office

of Surplus Property, which handles most consumers' goods, and the Maritime Commission, which sells ships, small craft, and marine fittings and supplies, there are several other disposal agencies. The Reconstruction Finance Corporation will sell capital and producers' goods, such as raw materials, manufacturing plants, real estate, machinery, airplanes and parts; and its subsidiary, the Defense Supplies Corporation, also will dispose of some surplus goods. The War Food Administration will sell surplus food. The Army and Navy, although selling large quantities through the disposal agencies, will sell certain small lots, mostly through their own salvage depots.

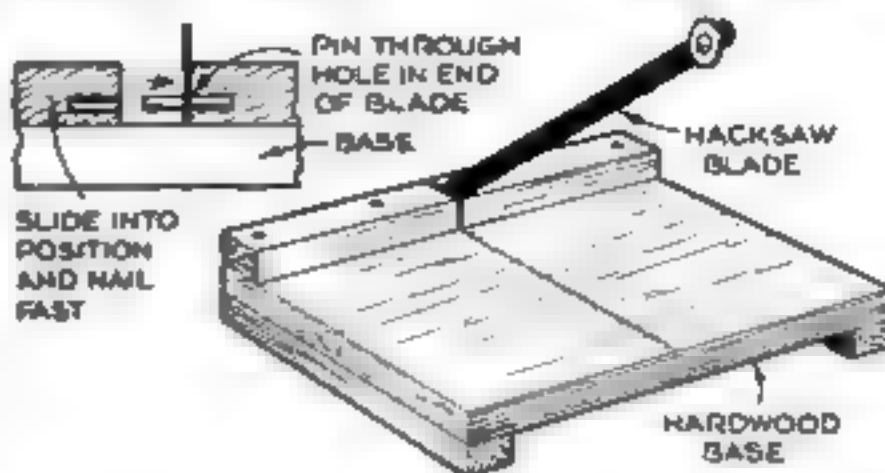
To co-ordinate the activities of all agencies in an attempt to avoid the many mistakes made in disposing of surplus goods after World War I, Congress has set up an overall policy-making body, known as the Surplus Property Administration. It will set the pattern for the sale of all Government surplus property, but will not actually conduct sales itself.

Phosphor Crystals Have Role in Postwar Electronics

PHOSPHOR crystals that absorb light and continue to shine in the dark will exert a strong influence on the postwar development of electronics, says Dr. H. W. Leverenz, of the Radio Corporation of America. In fluorescent lamps they will function as illuminants for homes, business buildings, and streets. Other phosphor crystals, it is predicted, will display news and entertainment on the screens of our television sets, while kindred phosphors in the screens of electron microscopes will aid in fathoming the mysteries of bacteria and molecules toward the end of promoting a healthier and happier life. Phosphor crystals have been known for centuries, but it remained for electronic research to put them to practical use. Through work with television, highly efficient luminescent materials have been devised to glow in almost any conceivable color.

Salvage every scrap of waste paper — old magazines, newspapers, wrappings, corrugated boxes, and outdated correspondence. It can be reworked into cases for blood plasma and other supplies for our fighting men.

Simple Paper-Perforating Knife



PERFORATING single sheets of paper, mimeographed forms, and thin cards for tearing "on the dotted line" is easy with this quickly constructed device. The base and paper guide are made of wood. The perforating knife is a length of old hacksaw blade and has a knob handle. Assemble as shown in the drawing above. In use, place the paper to be pierced on the base and bring the blade down sharply.—KEN MURRAY.

Novel Sandpaper Pencil Pointer



TO PRODUCE a fine point on a pencil, remove the metal knife from a plastic sharpener, insert the pencil, and lay a scrap of sandpaper over the groove, holding it in place with the left thumb. Light pressure of the thumb gives a long point—heavier pressure gives one with less taper.—K. M.



"Is that Dutch enough for you?"



WHEN YOU BUY NEW TIRES:

Choose the Name You Can Trust in Rubber!

The factors that dictate wise tire-buying have changed.

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signed" to the new tires you buy.

The name "Seiberling" molded into a synthetic tire means

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You can select a Seiberling Synthetic Tire with complete confidence. It bears

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SEIBERLING

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THE BATTLE OF RUBBER IS FAR FROM WON!

This war is consuming tires at a rate so fast no one could possibly have foreseen it. They are the most imperative single need of our armed forces today! One fighting unit alone requires 5000 in 24 hours. That means fewer tires for civilians. Continued conservation of your tires is essential. Your Independent Seiberling Dealer can help you make them last longer. You can trust him—he is an Expert in Rubber!



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lucky we had a tailor with us!"**

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THE CHANCES are that you are having difficulty obtaining "Eveready" flashlight batteries. We want you to understand the reason for this wartime shortage. Practically our entire production is earmarked for the Armed Forces and vital war industries.

After the war "Eveready" batteries will be plentiful again. And for your advanced information they will be even better . . . designed to give longer life, improved service.



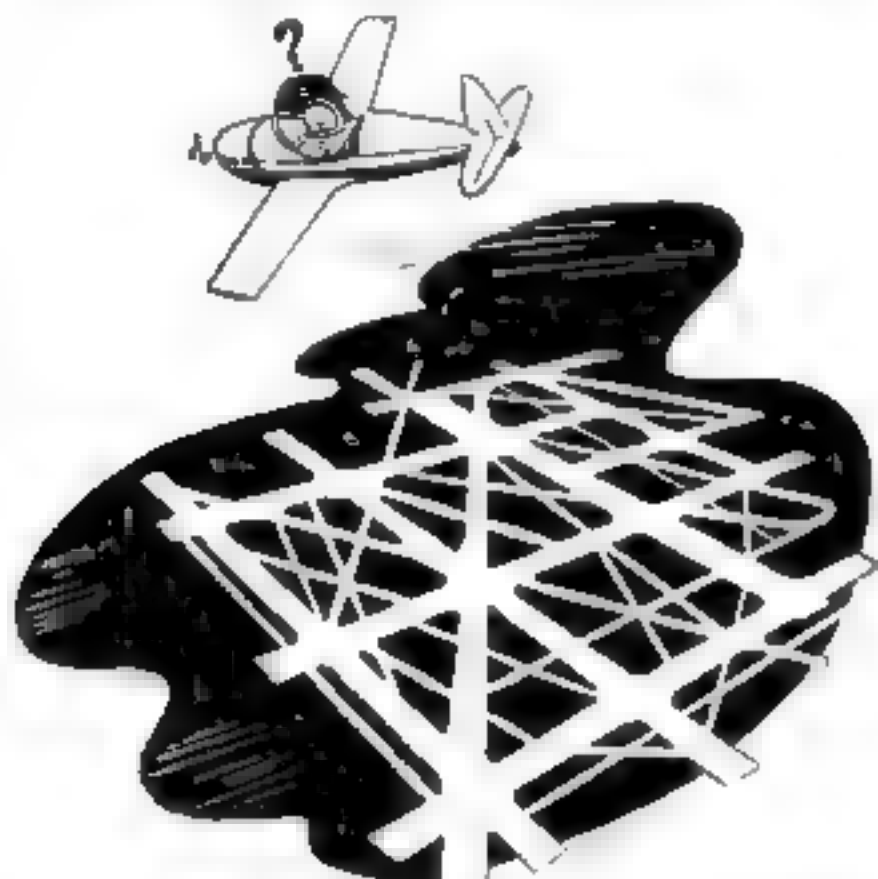
The registered trade mark "Eveready" distinguishes products of National Carbon Company, Inc.

No Flying Without Airfields

(Continued from page 81)

encouraging a shrinkage rather than an expansion of landing areas? If whirling-wing craft—which can take off straight up and land straight down—are first in popularity, will communities be dotted with relatively small fields, rather than a few larger ones?

To all these questions only the public can answer. Any air line or manufacturer would



"Okay, Tower! Just one more thing, please. How the devil am I going to find out which is Runway 2571?"

give a year's earnings to get those answers in advance. The trouble is that the public itself doesn't know them yet.

Using the only lamp by which man's feet are guided—the lamp of experience—manufacturers, air-line executives, and private flyers are counting on compromises in arriving at airport sizes and runway lengths.

While at least two manufacturers are planning the construction of airliners to accommodate 100 passengers or more, which would require 10,000-foot runways, Charles I. Stanton, Deputy Administrator of Civil Aeronautics, says:

"Twenty- to 60-passenger airplanes are going to be the backbone of our domestic air-transport system for some years to come, because they can furnish long-distance travel with intercity bus-schedule frequencies. Edward Warner, of the (Federal) Civil Aeronautics Board, concludes that 50-passenger airplanes are likely to be the best for transatlantic services also."

Cities, anxious to be on the main line of air traffic, are in a quandary. It is axiomatic among airport engineers that if you double runway lengths, you require four

times as much over-all area in an airport. They state, too, that if the terminal is placed in the center of the airport, with runways sticking out like the spokes of a wheel—a favorite current design of some of the planners—you again quadruple the size. That automatically pushes the airport farther from town. Great expanses of land rarely are available at the city limits except at prohibitive prices.

So compromises will be made. A few of the big cities will have super-airports with a few paved runways nearly two miles in length. Very likely these will be for airliners engaged in intercontinental flying. There will be hundreds of terminals with runways no more than a mile in length for intercity schedules.

Typical of the outsize airports to come is Idlewild, under construction for New York City. It will cover 4,057 acres, contain a dozen paved runways and, when complete, will be able to handle a theoretical total of 5,760 take-offs and landings each 24 hours. Chicago has under consideration a vast airport covering 3,600 acres fronting on Lake Michigan.

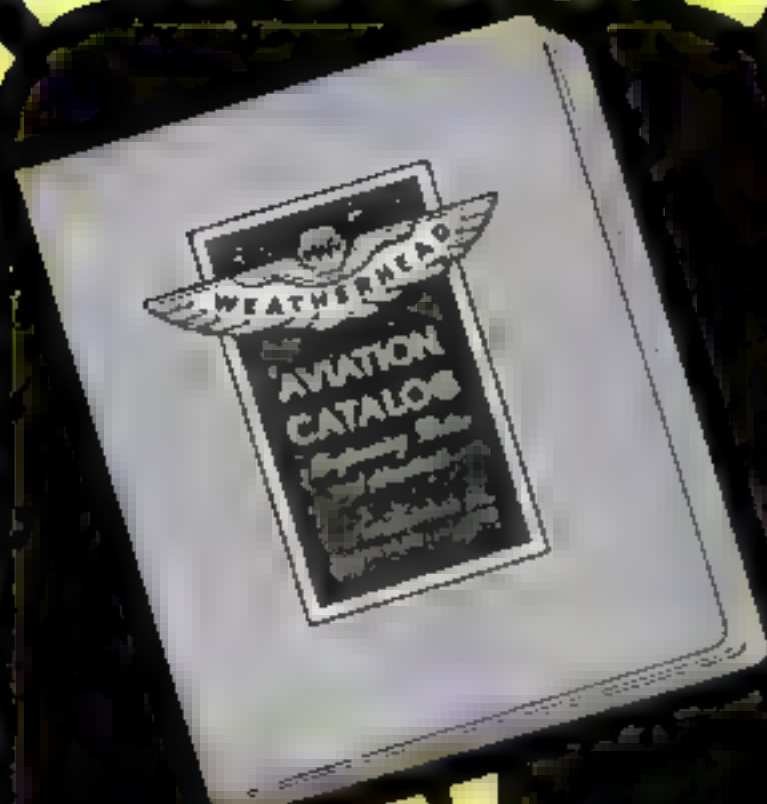
Of the first half dozen runways to be built at Idlewild, by the way, two will be 10,000 feet long, and the other four will scale down to 8,200 feet, 7,500, 6,500, and 6,000 (2,000 yards).

For airliner operation, airport saturation depends not on the size of the landing area but, instead, on the number of schedules that can be handled hourly. That, in turn, depends on the number of planes that can be dispatched and landed under instrument-flying conditions—when fog, snow, or heavy rain lowers the "ceiling" and reduces visibility. That, finally, depends on the installation of parallel runways and the refinement of radio aids.

Parallel runways now permit only six departures and as many arrivals an hour in instrument weather. Engineers are hopeful of boosting that to 30 in and 30 out—or one movement per runway each two minutes—in the next few years. In clear weather a movement of 70 planes an hour on one runway is considered feasible.

Just what the private pilot will have in landing facilities in the postwar years will depend in part on demand, in part on the vision of the men planning for the future of private flying. The utility of the private plane hinges on that hoary conundrum: Which came first, the chicken or the egg? Should private flying create the demand for

(Continued on page 812)



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No Flying Without Airfields

(Continued from page 211)

landing areas, or should landing areas create the demand for planes?

The national aviation planners are banking on an increased demand for planes if the landing areas are created first.

Very likely several hundred of the larger airports ultimately will be closed to private flying. Even now the big terminals discourage the patronage of the private pilot by charging him landing fees. (At New York City's La Guardia Field, for example, the minimum charge for a private-plane landing is \$2.50.) They don't welcome private planes for the same reason that a railroad terminal does not plan for, or welcome, the business of the private motorist.

In the postwar years the landing areas for the private pilot will have all the landscaped beauty of the express highway. They will cluster around the perimeters of the big cities, or, indeed, be built right within the city limits, within easy reach of the business district. They will be as much a part of the smaller community as the playground or the town square.

Nor will they be limited to that. Intermediate landing areas, probably to be known as "flightstops," will be sprinkled liberally throughout the country. In the form of T's or L's to provide take-offs and landings for all wind directions, they will be built at the intersections of major highways, and more than likely be adjoined by the counterparts of the automobile tourist camp. There the itinerant pilot can land in the face of a storm front or tarry overnight.

Col. Earle Johnson, national commander of the Civil Air Patrol, Army Air Forces auxiliary, suggests that both for the future of civilian flying and for the military security of the nation landing facilities can well be made postwar victory projects—taking the place of "useless" war memorials.

The national airport program is identified inseparably with national defense. Airports mean facilities for moving armies from one border of the country to the other by air overnight. They mean the opportunity to concentrate fighting and bombing planes at any point that may be threatened. They mean mass flying, and mass flying means a backlog of men who will know at least the rudiments of aviation if they must be thrown into military training in another emergency.

Tomorrow's airport-airpark-airstop-air harbor network gives promise of crystallizing what airmen have been talking about almost since the turn of the century—mass three-dimensional travel.

Engineer of the Flying Blanket

The Story of
Bob Sambleson

In Bridgeport today, in England tomorrow, Bob Sambleson works as if the outcome of the war depended upon him alone. And that's the spirit of his associates who stopped the peacetime manufacture of electric blankets and sent them sailing through the sky in the form of electric flying suits for the AAF. They give our fliers warmth and unhampered movement . . . when they are flying in the crippling cold of 60 below, four and five miles above the earth. *General Electric Co., Schenectady, N.Y.*



Bob Sambleson grew up on Long Island. He liked sports, radio, and Scouting. Canoeing up the Hudson River, with another Scout, was an early adventure.



He studied hard at Stevens Tech, won a varsity "S" in lacrosse, wrote a musical comedy for the college players, and was president of his fraternity.



Since graduation, Bob has been with G.E. at Bridgeport. His wartime job is designing electric flying suits; he often takes part in cold-room and flight tests.



Electric suits, plugged in like a toaster, keep our fliers toast-warm. Sambleson and his fellow-engineers have designed 285 electric garments.

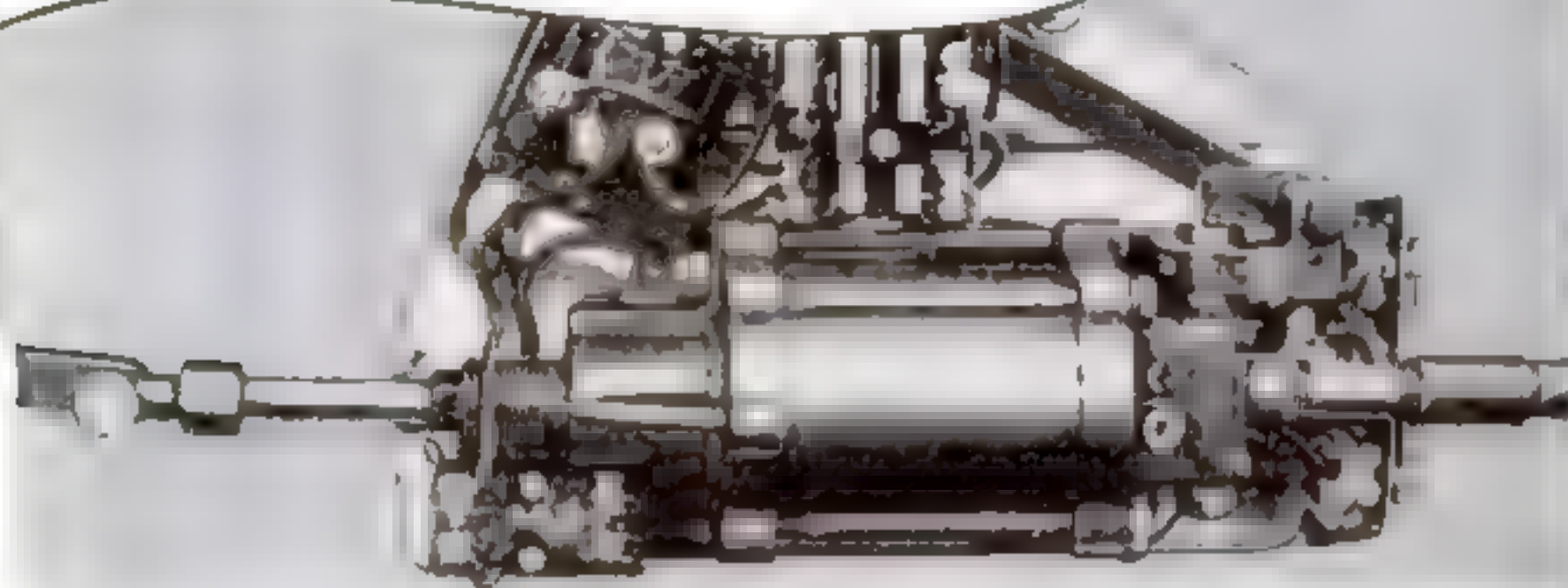
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"The World Today" news every week day 6:45 p.m. EWT, CBS.

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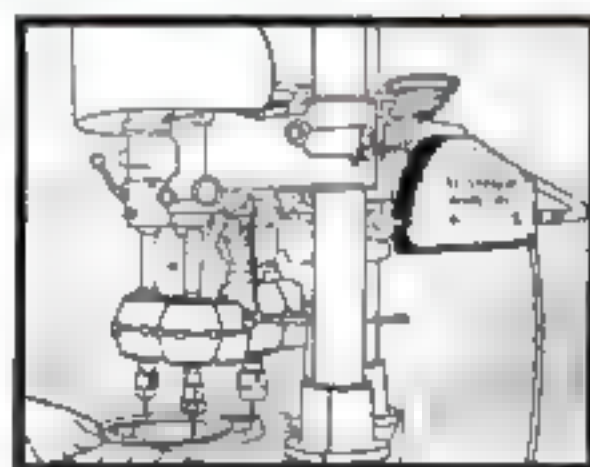
New Electroaire Power Unit Converts Standard Drill Press to Automatic

This exact control over feed and retraction speeds permits ready conversion of a standard drill press with tapping head into an automatic tapping machine, capable of producing Class III threads, even with comparatively unskilled operators. By adjusting speed to conform to the lead pitch of the threads being tapped, the tap will cut without forcing threads, and on the reverse the tap will actually "float" out of the part with no strain against the thread angle.

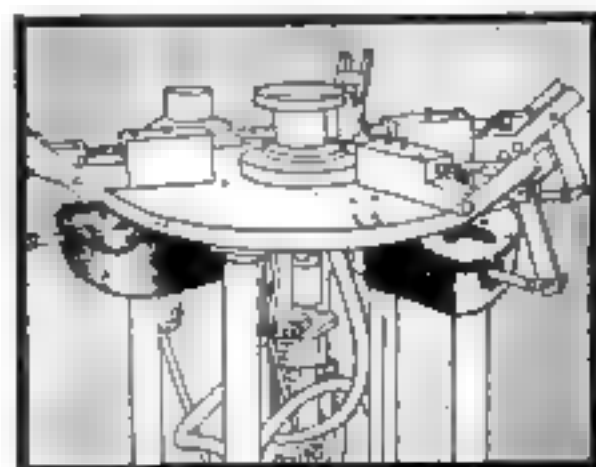
Air-powered jigs and fixtures can be opened, closed, and indexed by the Electroaire Power Feed. The unit can be set for a predetermined number of cycles so that multiple holes can be drilled in the same piece without ejection, by means of an indexing fixture controlled and synchronized by the Electroaire Unit. One operator can run as many as two or three drill presses, turning out top-quality work with few rejects and with a minimum of tool breakage, thus effecting a great savings in time.

Present stockpiles of finest quality materials used in the manufacture of Wrigley's Spearmint chewing gum are now exhausted—necessitating discontinuance of production. When a supply of proven materials—known to be up to the finest standards of quality—is again available, Wrigley's will resume production—And Wrigley's Spearmint will be back to again help you on your job. In the meantime they are manufacturing a war brand. Wholesome but not excellent enough for the Wrigley brand name.

You can get complete information from Electroline Manufacturing Company, 1975 East 61st Street, Cleveland 3, Ohio



Set up to punch 3 holes simultaneously



Shows holes being drilled
automatically



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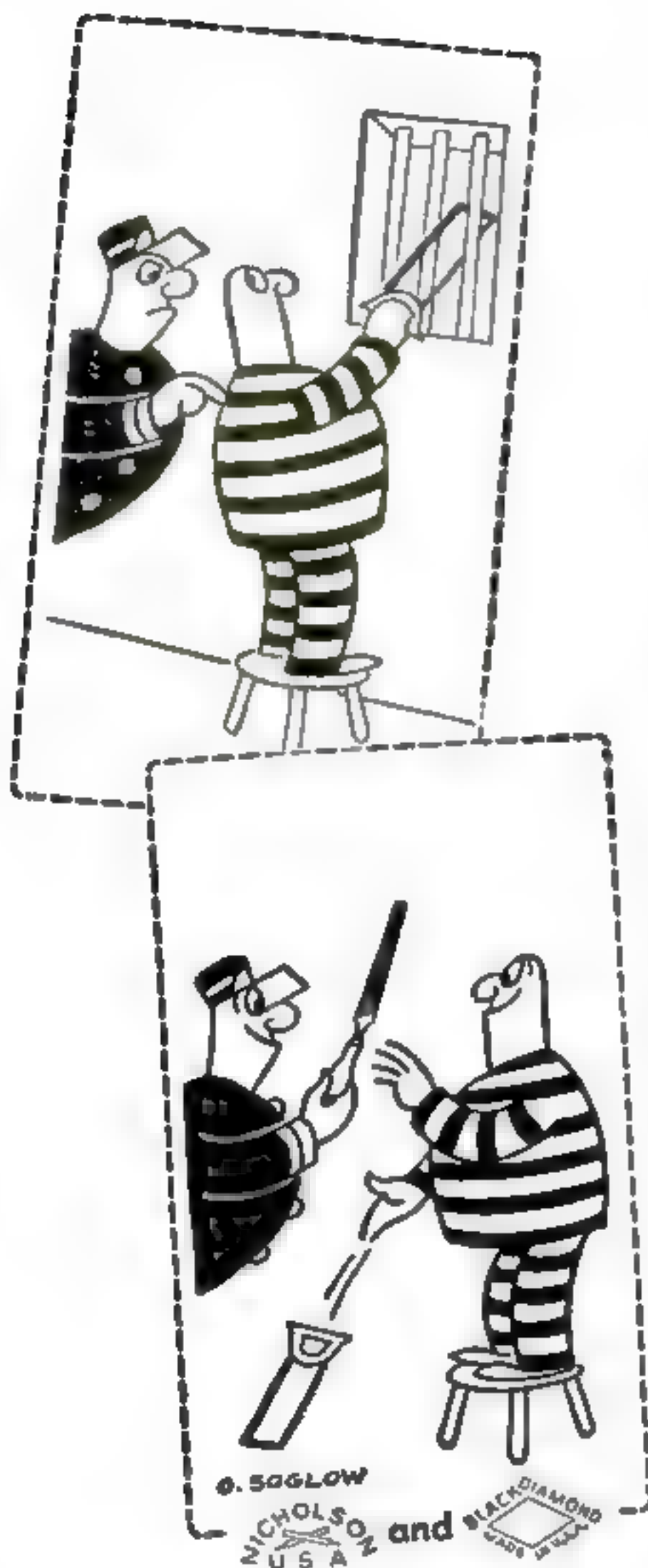
Bringing the same performance, dependability and extreme quality to automotive spark plugs that are required of spark plugs for a high-flying Super Fortress is the latest achievement of Champion Spark Plug engineers. Champion's research and engineering background, because it is exclusively devoted to the production of better spark plugs, brought invaluable experience to aviation from the automotive field. But wartime aviation put spark plugs to many extreme tests—stratospheric flight, supercharging, violent temperature fluctuations, 100 octane gas—all of which Champion-Ceramic Aircraft Spark Plugs met with extraordinary success. *Today* these same qualities, the same basic materials, precision manufacturing and design are yours in spark plugs for your car. Demand Champions, the spark plugs with aircraft prestige and efficiency. Champion Spark Plug Company, Toledo 1, Ohio.



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What's in the Basement?

(Continued from page 68)

where it was dropped. The scientists have considered, but not tried, putting a tiny radio transmitter on the pole so that it can send out an SOS when it breaks water.

Another, more sporting, method is generally used now to regain the 200-pound, free-floating, camera rig. Buoys, salt cubes, and weights are put on dummy poles, which are dropped at the same time that the important one is tossed to Davy Jones. By varying the amount of salt, these extra poles can be made to rise at 15-minute intervals. And by following these guideposts as they pop up, the photographers can be reasonably certain of finding the pole bearing their

Even though the apparatus is not attached to the ship, several exposures can be made on each descent. A clockwork, started by the pole's collision with the bottom, advances the film and clicks the shutter. Two pictures usually are taken because the first one is likely to be clouded by sediment stirred up by the pole. The first shot, in fact, often looks as though there were a cloud of dust on the floor of the ocean, but a second view, 30 seconds later, is frequently as clear as though the scene were on a sunny shore.

An ordinary large flash bulb can be sent down 60 fathoms (360 feet), and little bulbs can be lowered 650 fathoms without protection. For deeper dives, the little flash bulbs are placed in glass cups, exactly like the sediment cup on an automobile fuel line. Dr. Ewing also has obtained some 12-volt bulbs in Pyrex envelopes, three sixteenths of an inch thick and about two inches in diameter. These have proved satisfactory at a depth of nearly four miles.

Motorcycle batteries hung on the camera pole light the bulbs. The batteries are enabled to withstand the pressure by overfilling them with liquid and substituting little rubber balloons for the caps. The balloons permit equalization of the interior and exterior pressure. Very little insulation has been found necessary for the wiring. Lucite sleeves are placed around the electrical connections, however, in such a way that the increasing pressure of the water tightens the connections as the apparatus descends.

Best results have been obtained by hanging the flash bulbs below the camera on the pole, between the lens and the bottom being photographed. Cone-shaped reflectors are substituted for the platters generally used. And the photographers hope eventually to obtain special under water flash bulbs with built-in, conical reflectors.

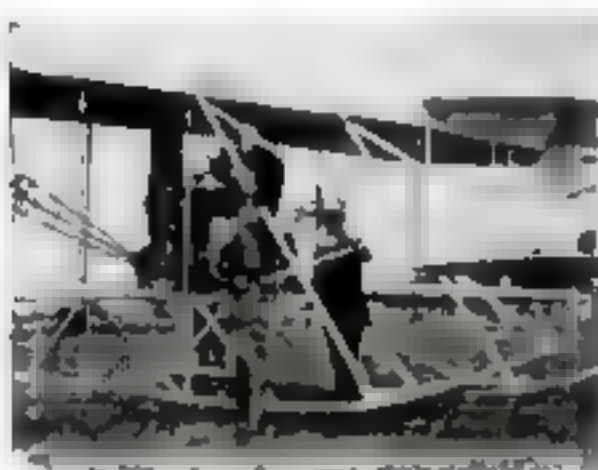
(Continued on page 220)

From a string on a strut...

To this...

IN THE EARLIEST days of aviation, airplanes had no instruments—and a pilot flew "by the seat of his pants."

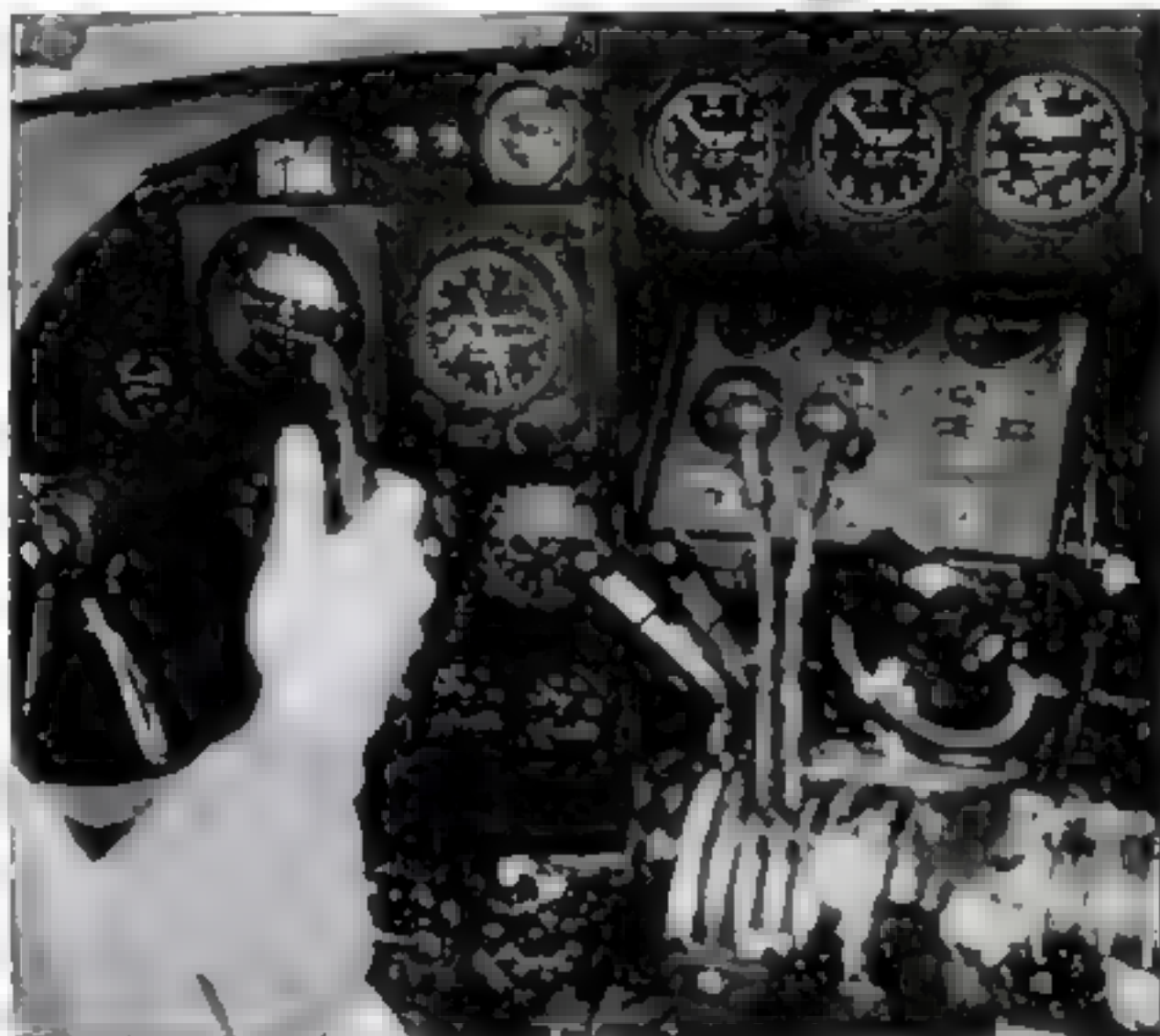
Sometimes aviators tied a piece



of string to a strut. In normal flight it whipped straight back. If the string deflected to one side it indicated that the plane was slipping sideways. But mostly they flew by the feel of the wind in their faces, and by direct observation of the ground and the horizon.

In 1914, at the beginning of World War I, flight instruments began to appear. One of the first was the Sperry Magnetic Compass for instrument panel mounting—a big improvement over former compasses of the marine type which were placed on the floor of the cockpit.

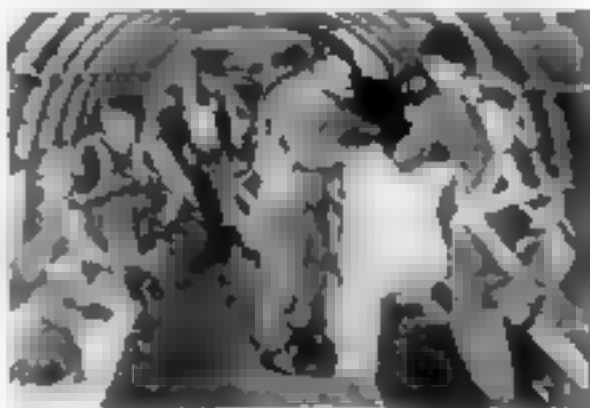
The Sperry Turn Indicator was introduced in 1918. It was so basic in design that practically every airplane that flies today carries an instrument of that type. A few years later another basic flight instrument appeared on instrument panels—the Sperry Directional Gyro. Being non-magnetic, it eliminated the swaying needles and magnetic error of the usual compass, and is still



Instrument panel of a Sperry "flying laboratory" showing the last word in modern flight instrumentation

found among the dozens of amazingly accurate flight instruments on which pilots depend today.

Sperry flight research has grown many times over, and it



Sperry engineers testing intricate flight instruments in a B-24 lent by the A. A. F. and fitted by Sperry as a flying laboratory.

embraces the new science of electronics in many of its projects. Under the stimulus of wartime demand, new devices have been developed in record-breaking time—and in record-breaking numbers.

Many of these developments

are secret. But it is one of the few compensations of war that many of them will someday be adapted to peacetime use. Radar . . . automatic flying devices . . . new types of compasses such as the Gyrosyn . . . the Attitude Indicator . . . instrument landing systems . . . airport traffic control instruments . . . and many others.

When that time arrives, Sperry's research laboratories will tackle the task of making peacetime flying safer, swifter, more economical, and more comfortable.

WAR BONDS—TO HAVE AND TO HOLD

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CORPORATION

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SPERRY GYROSCOPE CO., INC.

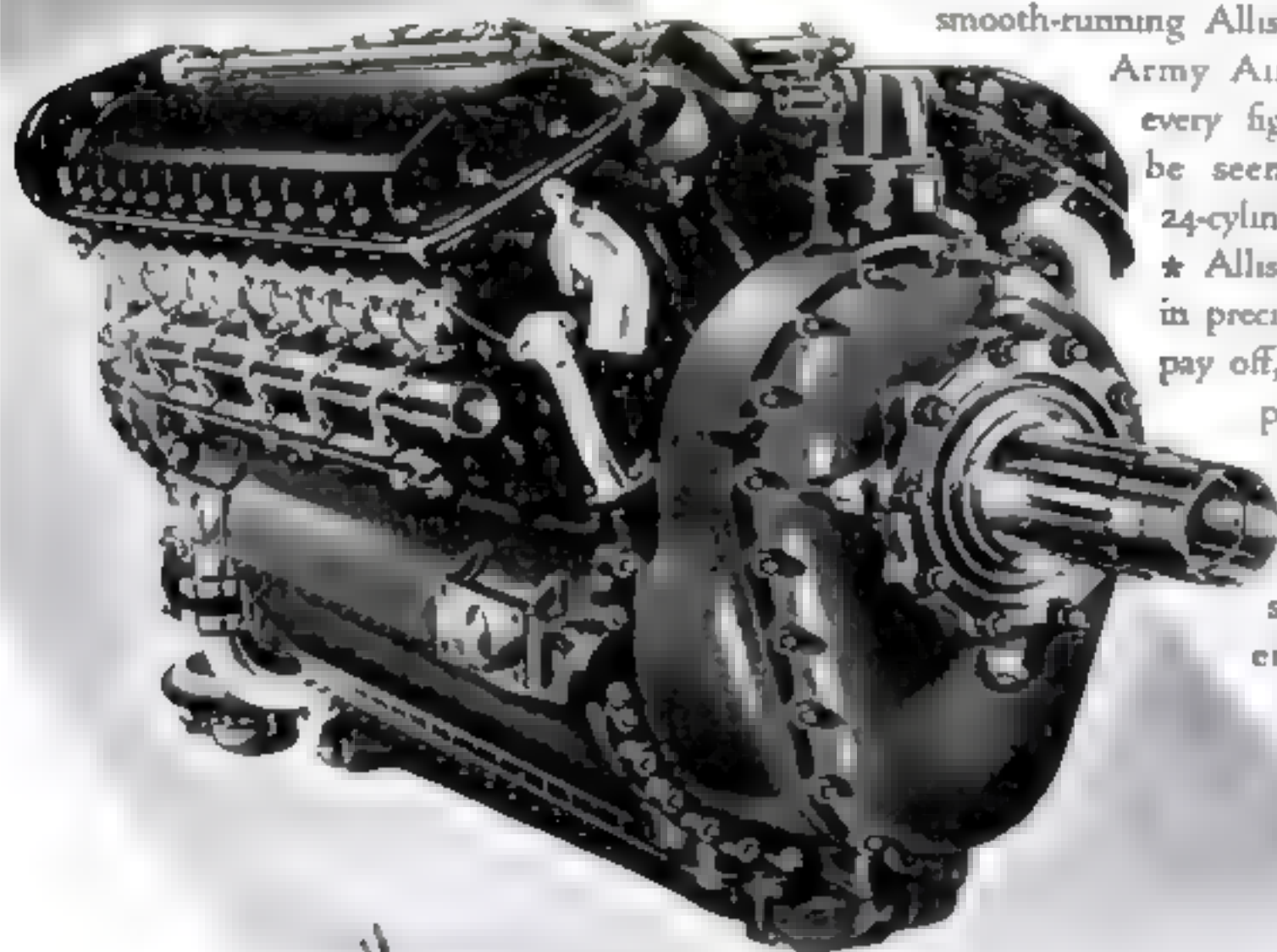
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Waterbury Tool Division, VICKERS INC.

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Army Air Forces planes on every fighting front. It can be seen in the powerful 24-cylinder Allison "3420's". ★ Allison's rare proficiency in precision with metals will pay off, too, in the planes of peace — emphasizing those qualities which make your flying enjoyable ★ And this same precision will endow any Allison product with the ability to serve you precisely right.



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DIVISION OF
Indianapolis, Indiana



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**KEEP AMERICA STRONG
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ROSEWILL II is a fine example of pre-war yacht construction by the Defoe Shipbuilding Company. Designed by William E. Ferman, Detroit, for the owner, W. C. Rault of Detroit, this 126-foot ship

was first of the yachts pointing toward streamlining. She is Diesel-powered—very roomy for her length with many outstanding features. She has been in service with the Navy since early in the war.

When It's Clear Sailing Again

In these crucial days every shipbuilder is producing only for Victory. So Defoe's job for the duration is to build fighting ships for the Navy. But some day there'll be clear sailing again for pleasure vessels. Then, it will be anchors aweigh for safer, swifter, more beautiful new yachts, embodying new materials, new power plants, new comforts and economies. One of the most interesting developments for ocean-going yachts will be seen in the advance of instrumentation. This will include the magic of radar, improved radio, electro sounding and gyro-compass control—combining the most perfect ship protection in the history of the sea. Postwar private craft built by Defoe naturally will reflect this organization's forty years of yacht-building experience as well as the new techniques and high standards of precision craftsmanship developed here in record-breaking construction for the Navy. Defoe's Yacht Division invites correspondence and will give individual attention to all inquiries.

CUSTOM YACHT DIVISION
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Four White Star Renewal Citations
now decorate the Navy "E" Award
won by Defoe workers.

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—BUY WAR BONDS

SHIPS FOR VICTORY
SERVANTS FOR PEACE

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*Valspar—
the Varnish
that won't
turn white*



*Valspar—
the Paint that
does it right*

for Home Repairs

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STANDS UP FINE!

An "ocean of Valspar" would hardly exaggerate the amounts used these war years! Millions of gallons of Valspar paints, varnishes and enamels are meeting the toughest of all tests—protecting our armaments and military installations against

Arctic blizzards and blazing tropical sun.

People at home who want the best in paints, enamels and varnishes have been using huge amounts of Valspar too. Valspar is the best you can buy. Valspar Varnish never turns white—Valspar paints and enamels give protection . . . lasting beauty . . . make home repairs easy! Ask your dealer for Valspar—today!



What's in the Basement?

(Continued from page 216)

Peacetime probing of the depths with the photographic apparatus now available is almost certain to yield new clues to many mysteries. Dr. Beebe reported after his record-smashing bathysphere descent that "there are so many interesting things down below that you cannot hope to remember them all when you come to the surface." But the camera does not forget. Nor is it affected, as the mental processes of divers may be, by the pressure at great depths.

Life is more abundant in the ocean's lower stories than in its upper stories. The denizens of the deep perish if brought up in nets—possibly, too, only the weaklings are caught. "Photography," says Dr. Ewing, "appears to be the only certain method of taking a census of the population."

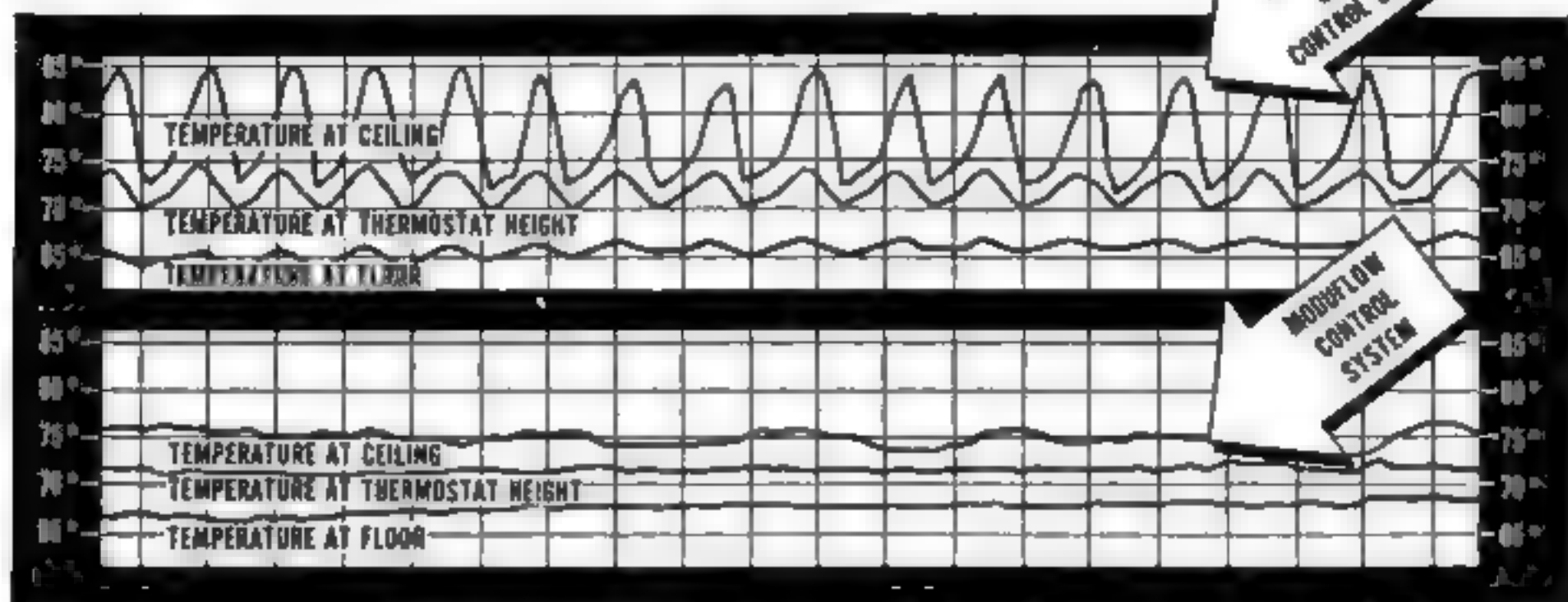
Conceivably, luminescent organisms will be found in the bottom of the big oceanic basins. Although the fish that dwell about midway down can hardly see at all, the creatures that live farther down sometimes have well-developed eyes, like those of the fish that frequent the surface. Hence, some scientists suspect that there may be some source of light in the areas far beyond the sun's rays.

Mysterious tracks have been found in many of Dr. Ewing's pictures of the sea floor, and the use of bait to lure the makers of those tracks within range of the camera is being studied. Dogfish sharks already have cavorted before the lens at greater depths than the biologists suspected them of descending; surprisingly thick beds of starfish, oysters, and sand dollars have been discovered; and the botanists have been shown photographs of sea ferns, like those formerly found only off the coast of England, growing beneath the Atlantic near the American shore.

Until recently, geologists doubted whether waves rippled the sand more than 30 fathoms (180 feet) below the surface. Now they have photographs of ripple marks 100 fathoms down. This is a fact of considerable significance, because these marks are a means of determining the conditions under which sediments are deposited.

Previous explorers have obtained samples of the oozes and rocks beneath the oceans by shooting special underwater guns into the bottom. In these materials, evidence has been found that the world is at least 1,300,000,000 years old. By photographing as well as lifting out and analyzing parts of the foundation under the seas, much more may be learned about things that happened long before Adam and Eve.

See the Difference..

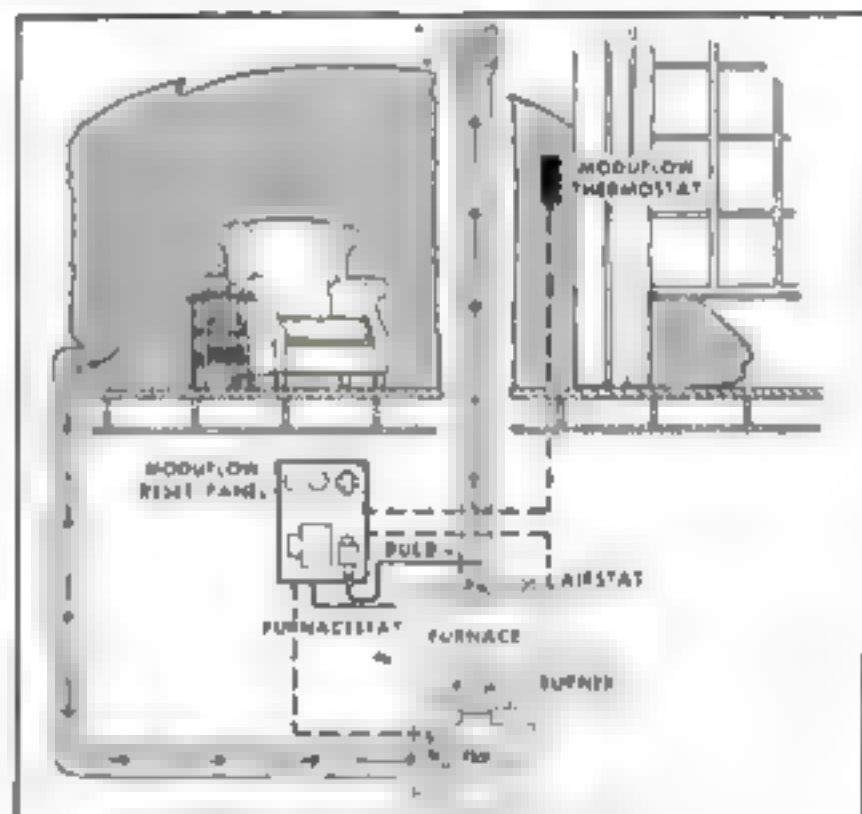


BETWEEN MODUFLOW AND CONVENTIONAL HEATING *Control* SYSTEMS

THE CHARTS above are actual temperature recordings taken from two identical houses. One was equipped with ordinary "on and off" heating controls. The other was equipped with MODUFLOW, Honeywell's remarkable new heating control system. Compare the ups and downs of the old system with the smooth, even comfort of MODUFLOW. Moduflow eliminates wasteful overheating and drafty, cold floors . . . Every home can afford the greater comfort and efficiency of Moduflow.

HOW *Moduflow* WORKS

Moduflow operates on an entirely new principle. It can be used with most automatic heating plants, either hot water, warm air or steam. Shown here is a warm air system. The heavy black lines show the simple additions required. Room temperature is controlled by the Moduflow Thermostat while temperatures of the warm air supply are governed by the bulb in the duct. The Reset Panel, operating at the command of these instruments, controls the burner and fan. Air at the right temperature is continuously circulated. Send coupon for the complete story of Moduflow.



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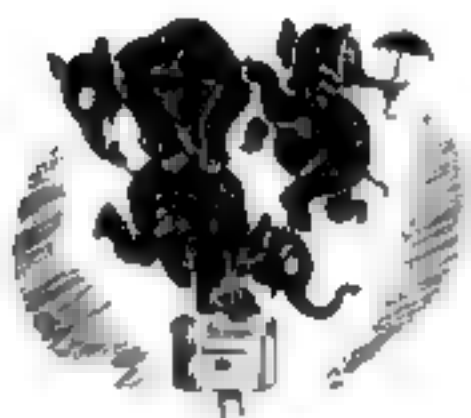
City State



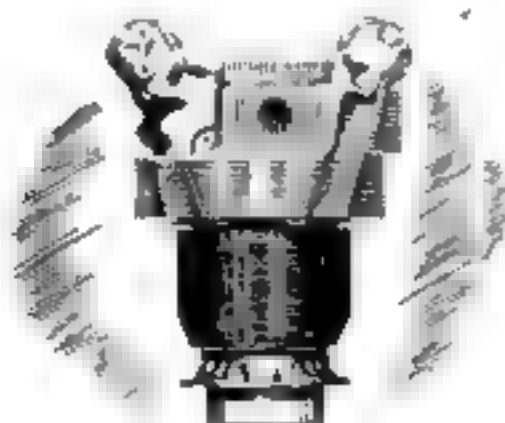
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HORSEPOWER

in each wing



SHOCK ABSORBER: On the power strokes, each piston in a Wright Cyclone has to absorb a blow of 15,000 pounds, or a force equal to the weight of three elephants. The full weight of this force hits a piston face only 6½ inches in diameter.



WEIGHT-KILLER: This is the Wright-designed forged cylinder head which cuts weight from aircraft engines. Stronger than cast aluminum heads, its extra power cuts weight per HP. This cylinder alone will turn out 150 HP, enough to power three training planes.

Equal in power, a locomotive and a Wright Cyclone aircraft engine make an amazing contrast in size and weight. Both develop 2,200 HP. Yet the Cyclone, with its 55-inch diameter and weight of only fractionally over a pound per horsepower, would fit easily into the cab of the 200-ton locomotive.

A vast difference in bulk is one reason why locomotives ride on rails while Cyclones fly. All aircraft power is a specialized field—tremendous power packed into small space at low weight, but Wright engines lead this field, for they are highest in power, lowest in weight. That's why Wright engines have powered leading planes for 25 years.

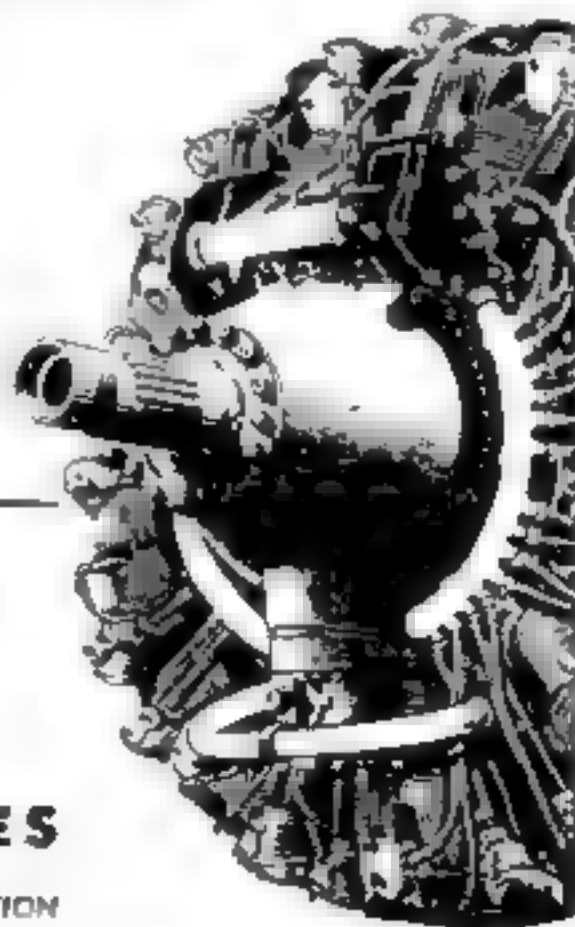
Write for "ENGINEOLOGY"

a 100-page booklet on the "Why" of engines

A complete, non-technical booklet on engines and their relation to planes and propellers. Describes operating principles of engines. Explains combustion, supercharging, ignition, carburetion. Just send twenty-five cents in stamps or coins to: Wright Aeronautical Corporation, Dept. P. S., Paterson 3, New Jersey.

WRIGHT AIRCRAFT ENGINES

A DIVISION OF CURTISS-WRIGHT CORPORATION



Here's how your car FEELS...

... after
MARFAK
chassis
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"She sails along beautifully," you'll say to yourself, after your car has received a MARFAK chassis lubrication job. And it'll stay that way, too. Because Texaco MARFAK sticks to the job, resisting washout, squeeze-out, wearout! MARFAK is always applied by chart, never by chance. Eliminates the possibility of missing a king pin or control arm lubrication fitting. Ask your Texaco Dealer to give your car that "MARFAK feeling" today!

THE TEXAS COMPANY



MAKE THIS TEST!
When your car is ready for its next chassis lubrication job, make special note of its riding and handling qualities. Then have your Texaco Dealer MARFAK your car. Now try it out on the roughest streets, on sharp turns. Then when you can feel the difference that MARFAK makes.

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The Best Marlin RIFLES SINCE 1870

● Marlin is ready to produce its outstanding line of accurate, dependable .22's as soon as war contracts permit. They will be the best Marlins in history—built to standards of performance and long life that made the name famous. Now is a good time to look over the Marlin line. Send for catalog today!

Illustrated. Model 80-DL

CLIP MAGAZINE REPEATER CAL. .22

8 shots "at a clip" for small fur-bearing game and pests. Recommended for target practice by N. R. A. A man-sized gun at a low price.

Model 81-DL 25-shot Repeater. Bolt action tubular magazine .22 for general purpose hunting of small game, without need of frequent loading.

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Model 29-A. Lever Action Repeater. By many considered world's best all-around light rifle. Only lever action .22 made. All working parts exposed by turning of single hand screw.

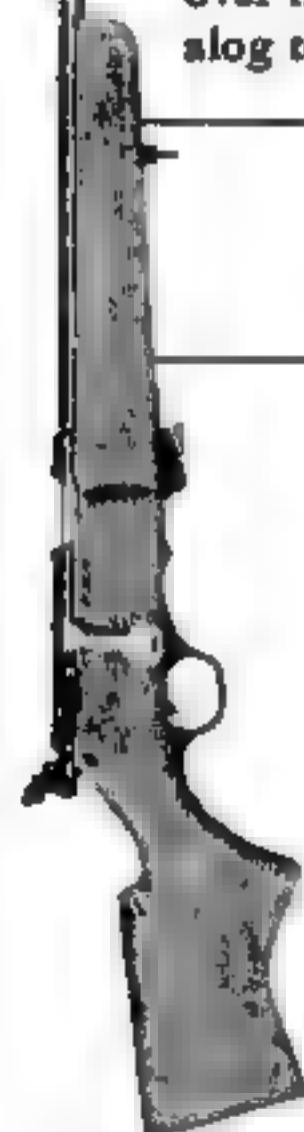
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Handsomely illustrated pre-war catalog, with full specifications of Marlin Guns.

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Enclosed 3c for mailing catalog of Marlin Guns.



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PS-2

WATCH THE INFANTRY ——— THEY CARRY THE GUNS!

"Plumber's Nightmare"

(Continued from page 71)

mixes with kerosene in the combustion chambers, and is ignited. It blasts out through the flame pipe, and that's all there is to it. How the hell that makes an airplane fly, I don't know."

Engineers, explaining the jet force which drives a plane, have compared it to the strong, sudden whip at the nozzle of a garden hose when water is turned on full force.

"Most mechanics are surprised to learn that there are only eleven bolts holding the engine in place," the sergeant comments. "And not very big bolts at that. In the engine there are but two main bearings and one shaft.

"I can pull an engine with an inexperienced crew in 35 minutes, and four men can pull both engines and install new ones in a day. Where we used to spend five days doing a certain job on a conventional plane, we can do the same thing for a jet in a day. Where other mechanics would use 25 wrenches for a certain type of job, we generally use about five."

All the equipment necessary for changing a jet engine can be carried in the plane, and this consists of a small wing hoist and frame, and a cradle to support the engine when removed. Since the unit is so close to the ground, no work stands are necessary to reach any part of it.

Mechanics invariably ask about the jet exhaust and want to know how close a person can stand in front or behind the engines, Kohler says. Most of them have heard fanciful stories about women having their dresses whisked off by the suction of air going into the engines. And there is one story, widely told, of an officer who tried to look into the rear end and got his cap visor scorched off back to the eagle. Kohler does not believe these tales, but he does know a guy who stepped into the exhaust and was kicked back 70 feet in fast somersaults.

"I'd say a person should keep at least 200 feet behind a jet engine when it is blasting," the sergeant recommends. "You can stand closer without getting hurt."

Once a flight is over, mechanics don't need to let the plane cool off before beginning work on the engine. By the time they get the cowlings off, the engine is cool enough to be taken out.

Development of the AAF jet plane, one of the best-kept secrets of the war, took place at Muroc, Calif., where Kohler said he signed away his life every day. "Every

(Continued on page 228)

Meet the Men

WHO USE YOUR BATTERIES!



The Navy and Merchant Marine send rapid ship-to-ship messages by battery-powered flasher signal lights when radio might give a ship's position to the enemy.



It's difficult to locate men drifting in the sea! Water-tight battery lights on buoyant lifeaver suits have saved the lives of many torpedoed Merchant seamen.



For emergency communication by voice, the Merchant Marine uses a portable megaphone to broadcast orders and instructions. Dry batteries power the megaphone.



Two men and a bazooka make a winning team! But it takes large quantities of ammunition and dry battery power to keep these portable, hard-hitting weapons firing.



Deadly flamethrowers are blazing the road to Victory! Dry batteries create the spark that sends these efficient weapons into instant, flaming action against the enemy.



The Signal Corps man with a Walkie-Talkie has freedom of speech as long as he has plenty of dry batteries! Handie-Talkies are also powered by war batteries.



When they come Home — Burgess Batteries will be back again, too ...powering flashlights, radios, telephones, instruments and controls for millions of homes, farms and industries throughout America.

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The tough Liberator bomber is systematically wrecking Axis war industries and vital military installations, from Bangkok to Berlin, to hasten the day of Victory.



In rebuilding the peacetime world, huge Consolidated Vultee planes will play an important role in the swift transportation of goods and people over global skyways.

Other planes designed and built by Consolidated Vultee are:



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SENTINEL . . . "Flying Jeep"

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The **BIGGEST** Fish are where you find 'em

"No muskie here", Charley the guide had said . . . and then the old warrior struck . . . smashed the lure like a bolt from the blue . . . and exploded into a battle worth a week of any man's fishing! Which makes the best of guides look sheepish—and proves the truth of the old adage, "the biggest fish are where you find 'em".

For 35 years . . . stalking every variety of game fish in every kind of water . . . fishermen have been finding 'em with Evinrudes. The matchless experience of these Evinrude owners has constantly contributed to the development of features every fisherman wants. With peace, they will again be yours . . . in motors still finer for fishing, and for every other service.

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BUY MORE WAR BONDS



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TRANSCONTINENTAL RECORD

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SEATTLE TO WASHINGTON—6 HOURS, 3 MIN., 50 SEC.

MORE THAN 383 MILES AN HOUR

AC Ceramic Aircraft Spark Plugs fired all four of the great Wright "Cyclone" engines which carried the mammoth Boeing-built Army transport 2,323 non-stop miles—and broke the speed record for planes of any size.

Achievements like this demand *utmost reliability*—the quality for which AC Spark Plugs have been known to motorists, operators of buses and trucks, yachtsmen, and farmers since 1908. This same reliability is also now serving our armed forces, in the air, on the ground, and on the water—and is keeping essential transportation on the job all over America.

AIRCRAFT SPARK PLUG



ACME NEWS PHOTO

AC SPARK PLUGS

SPEED FINAL VICTORY—BUY WAR BONDS

"Plumber's Nightmare"

(Continued from page 224)

time I turned around I was signing something, promising that I would keep my mouth shut."

Even the commanding officers at an AAF base near by did not know what was going on inside the restricted area of the desert. Pilots were forbidden to fly over it and no amount of rank could get a curious officer into the field. On several occasions, the jet plane was seen smoking through the sky and frantic telephone calls came from the neighboring air base notifying jet crews that a burning plane had fallen on their field. The callers were politely thanked for their concern.

One afternoon, when the experimental plane was smoking heavily, the neighboring air base called out its fire and crash equipment and sent it clanging down the highway to the secret station. The crash wagons pulled up at the main gate and demanded to be let inside, drivers shouting that they had the location of a burning plane.

Again, the guards were compelled to thank them quietly and politely—and keep the gates locked. On another occasion a bird colonel became so curious that he drew himself up to full height before the guards and demanded to know what was going on behind all the secrecy and mystery. A security officer had to be called out to pacify him.

"Colonel," he said, "behind those hangar walls is the hope of tomorrow. We are coming out with a gadget that will revolutionize the sewing machine."

Perhaps the simplest function of jet maintenance is servicing the plane with fuel. This is no more involved than calling the kerosene truck and filling up. The fuel is thoroughly filtered to safeguard the barometric fuel controls. These units do what the regulator on a turbo-supercharger does—they maintain a constant power with changing altitude. The engine can operate on nearly any hydrocarbon fuel such as gasoline, kerosene, alcohol, and even hair tonic or brandy.

The jet engine has about 10 percent as many moving parts as a reciprocating engine and, since there is only a rudimentary ignition system and no carburetor, there is no elaborate mixture control, nor prop control, nor icing worries.

"You get all that in something they call a plumber's nightmare," Kohler says. "I take them apart and put them back, and I still can't find what makes them fly. It's the airplane of tomorrow—and it smells like an old oil stove."

Andy Langdon at his Atlas lathe in his fine new plant in Glendale, California.

WITH *Atlas*



FROM GARAGE SHOP to MODERN PLANT IN THREE YEARS

Three years ago a tool salesman—today owner of a modern new plant, busy on highly precise aircraft tools, with plenty of plans for postwar business—that's the "success story" of Andy Langdon. His interest and skill in machine work came from an Atlas lathe and Atlas drill press in his basement workshop.

He foresaw the need for special precision tools, enlarged his garage, added an Atlas lathe, and started business. Soon he was forced to move to the white building shown

above. But his work and staff kept expanding until he needed to build for himself.

His specialty has been work for Douglas Aircraft on tiny parts only $1/16$ " in diameter to full Atlas lathe capacity with tolerances of .0005".

SEND FOR LATEST CATALOGS

Are you planning on a home shop after the war with the idea, perhaps, of writing a "success story" of your own in the busy times ahead? We'll gladly send catalogs.

New Atlas pattern service for wood craftsmen. See ad on page 238.



ATLAS PRESS CO.

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VanRoy

Van Roy Size \$5

*Signet of Quality
in Pipes*



VANROY COMPANY, INC. ■ ■

MOMENTS of relaxation are enriched by the rare contentment of smoking a VanRoy—the pipe with a noble heritage of distinguished quality. Be discriminating in your choice of pipe companionship—select a VanRoy.

■ IMPERIAL STATE BUILDING, NEW YORK, N. Y.

Fast Starting, Smooth-Running Horsepower

FOR YOUR CAR



65¢

A PINT

CASITE

**GUARANTEES SUMMER STARTING
IN WINTER WEATHER OR
DOUBLE-YOUR-MONEY-BACK**

CLEANS OUT MOTORS • KEEPS MOTORS CLEAN

A pint in the crankcase every oil change and a
pint through the air intake every three months.

Your car dealer, service station or garage will
supply guarantee certificates.

THE CASITE CORPORATION • HASTINGS, MICHIGAN

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While planning to enjoy making things in your postwar home workshop, remember that a fine assortment of Stanley Tools will add good craftsmanship to recreation. Stanley Bit Braces, for example, have long been the choice of professional experts in woodworking. Featuring shorter chucks, stronger jaws, improved head construction, fine finish, Stanley Bit Braces will turn out work you'll be proud of.

Let Experts Help in Your Selection

Stanley has a free booklet for you, "The Joy of Accomplishment." Crammed full of helpful suggestions for the hobbyist, it contains: a primary list of tools and a list of tools to be added as needed. You'll also find the big Stanley textbook: "How to Work with Tools and Wood," mighty useful. It's yours for only \$1.00. Mail the coupon today.

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Please send by return mail

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How Zoom Boats Sock

(Continued from page 84)

they can be fired so that each salvo overlaps a previous one. Targets may be determined by using ranging rockets. And the blast effect and fragmentation from a barrage of bursting rockets can be employed to make the area where men are about to land too hot and lively for the foe to linger there.

Secondary fortifications, including mines, wire, machine-gun nests, and shallow pill-boxes can be virtually eliminated. Even men protected by large, strong fortifications can be temporarily stunned by a rocket bombardment.

The 4.5-inch rocket, moreover, is only one of several calibers now in use. The smallest is called a SCAR, sub-caliber aircraft rocket, and is only 2.5 inches in diameter. The largest is five inches in diameter. Recent developments, however, have made it possible to produce bigger rockets, aim them more certainly, and use them at longer ranges. For example, it has been suggested that an automatic computing device similar to the electronic bombsights now in use might enable a fighter-plane pilot to launch rockets at a target with greater accuracy.

Since there is no recoil, the apparatus from which rockets are launched can be lighter and much simpler than a gun. The U.S. Navy put rocket launchers on its LCS (S), landing craft, support (small), while the British were putting them on their LCT (R), landing craft, tank (rocket). Some of the latter craft were turned over to this country more than a year ago. After careful tests, Navy authorities ordered more of them converted to American designs and specifications with the utmost speed. Until recently, these vessels were definitely hush-hush.

Meanwhile, rockets were used with sensational success on the Navy's LCI (G), landing craft, infantry (gunboat), in the Pacific. A single LCI skipper estimated that his craft fired 1,000 rockets into the beaches of Guam.

Washington authorities report that the Japs have made comparatively little use of rockets. But American officers have found that invasion casualties can be reduced by using more rockets.

The Army is directing the production of propellant powder, and the Navy is in charge of assembling, loading, and testing rockets. Home-front workers are being asked to turn them out faster, in greater quantities, to save American lives.—VOLTA TORREY.

Your Coming New Zenith will be the World's Finest Radio because

All Zenith's Engineering Power is Concentrated on

"RADIONICS EXCLUSIVELY"

THE vast new science of RADIONICS is a jealous wife. She demands undivided devotion from him who would share her secrets and master their application. Many of these secrets are still so sensational that they cannot even be made public!

It is only natural that you can expect the world's foremost radio values in the coming new Zenith Radionic models. For Zenith does not divide its engineering and manufacturing power among unrelated fields like refrigerators, washing machines, electric irons, cooking ranges and vacuum cleaners. Zenith has no intention of competing with lifelong specialists in those fields.

RADIONICS demands a degree of imagination in engineering and precision manufacture unknown in other mass production fields. That's why every Zenith worker has always been, always will be, a highly trained specialist in "RADIONICS EXCLUSIVELY."

BEFORE the war, this policy made Zenith one of the largest radio manufacturers in the world... with an unrivaled record of top performance in millions of sets, at lower service expense to owners than any other make!

In the war, "RADIONICS EXCLUSIVELY" has made Zenith Radionic military equipment famous in every branch of our armed forces! This has meant a wider, more intensive development by Zenith in High Frequency, the basis for all FM, Television and Short Wave advancements. It is a matter of record that years ago short wave communication was introduced into the U. S. Navy by Zenith.

No wonder Zenith—and only Zenith—is able to launch a RADIONIC REVOLUTION!

YES, your coming new Zenith Radionic Radios, Global Portables and Radio-Phonographs will bring miraculous tone of such clarity, brilliance and beauty as you've never heard before! They will combine advanced engineering, precision quality and low cost as never combined before!

The ZENITH RADIONIC REVOLUTION is on the way! Watch for it! Don't risk your radio dollars—put them on a name you know will be a proven winner. Keep your eyes on Zenith for the best in radio, and see Zenith first!

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All Production Now for War or Rehabilitation

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**motors, too,
need a spring tonic!**



AFTER a tough winter's work, motors get sluggish, unresponsive — downright lazy. The faithful old engine has spring fever — caused by accumulated sludge, gum and acid in the lubrication system. What it needs is an internal bath—**LOOSITE**—to clean out the engine—thoroughly, safely, economically . . . then a tonic—**SILOO**—to prevent further accumulations of dangerous petroleum residues and corrosion.

Have your service station or dealer give your car both treatments—**LOOSITE** to clean every vital part of the lubrication system . . . and **SILOO**, added to fresh crankcase oil, to keep it clean. It's simplicity itself . . . and you'll avoid costly layups and repairs resulting from gum and sludge.

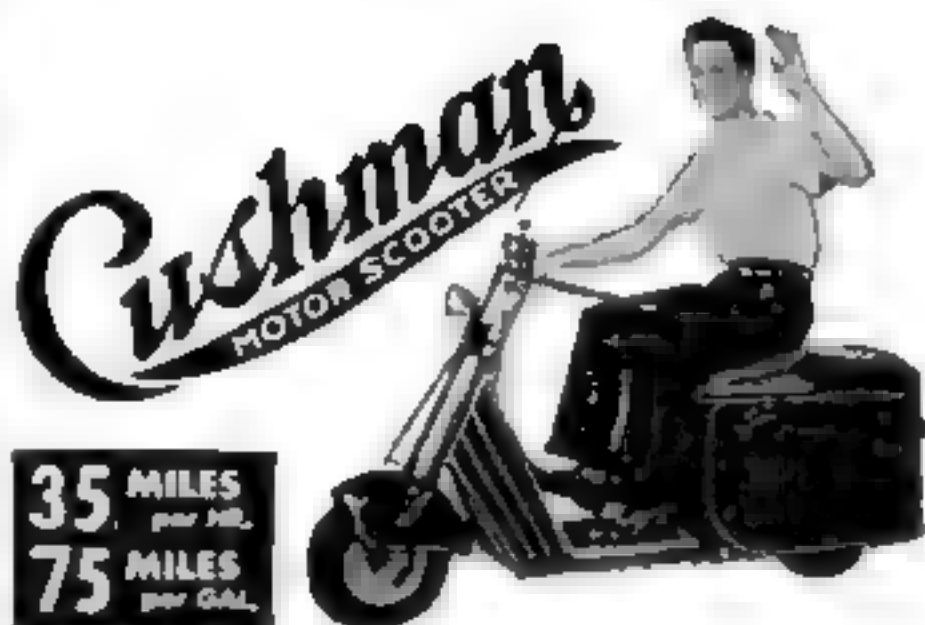
Cars must last longer! Give yours the break it deserves — **LOOSITE** and **SILOO** for better performance and prolonged usefulness. See your service station or dealer now!

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LATER, for general use

Want to scoot around **FAST**, at **Amazing Low Cost**? Then, pick the New Improved **CUSHMAN**! Beats anything you ever saw. Ten times faster than walking! 500 miles on \$1 worth of gas! Built for long, hard use!

So practical, economical and durable that thousands now serve in the nation's great war plants.

POWERFUL 4 H. P. ENGINE. No clutch pedal or gear shift. Floating Drive applies power smooth as Fluid Drive. Hand accelerator controls starting and speed-adjustment. Special springing, long wheel base and balloon tires provide Smooth Riding. Low center of gravity and heavy brakes provide Safety.

2-wheel and 3-wheel models with 200-lb. and 250-lb.-capacity package boxes.

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● For a smoother, faster cutting job, Atkins Smooth End Trimmer shown here is tops. Its design, and keen edge-holding teeth cut smoothly without splintering the ends or edges of cuts. What's more, these saws keep right on making glue-smooth cuts for long periods without filing. The saw shown is one of many types in Atkins Circular line. If your dealer doesn't have the one you want, remember that Atkins energies are still all-out on war work. Send a dime today for the useful Atkins "How to do it" book.

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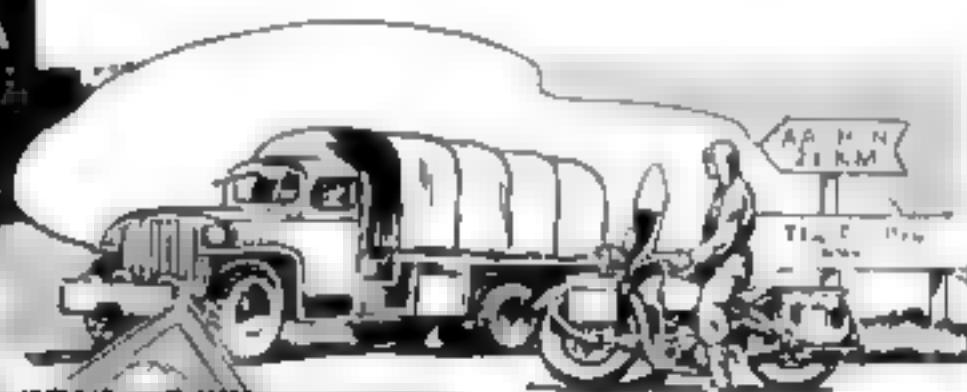
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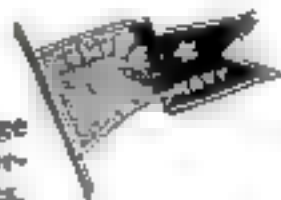
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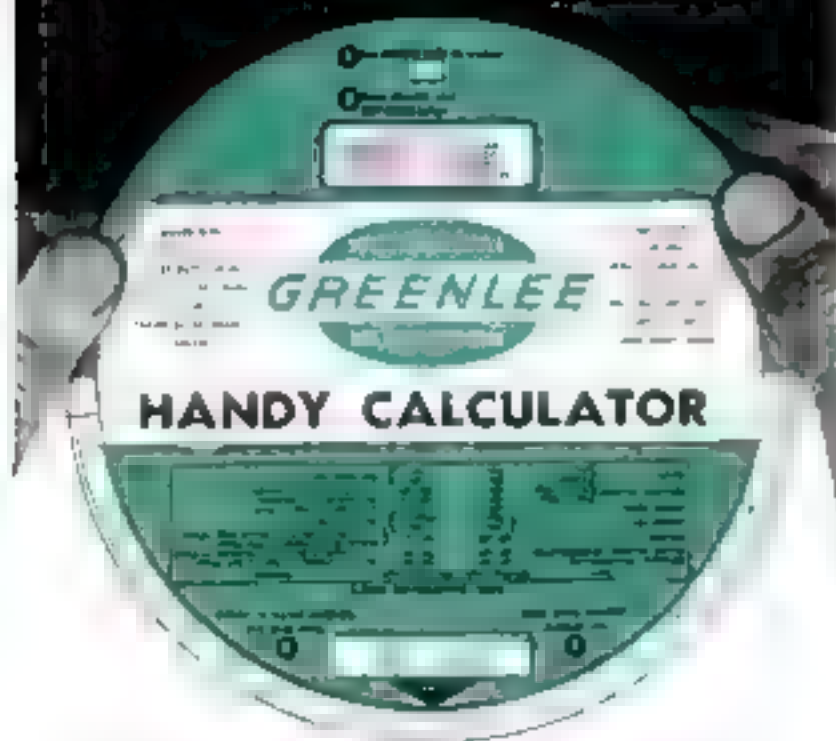
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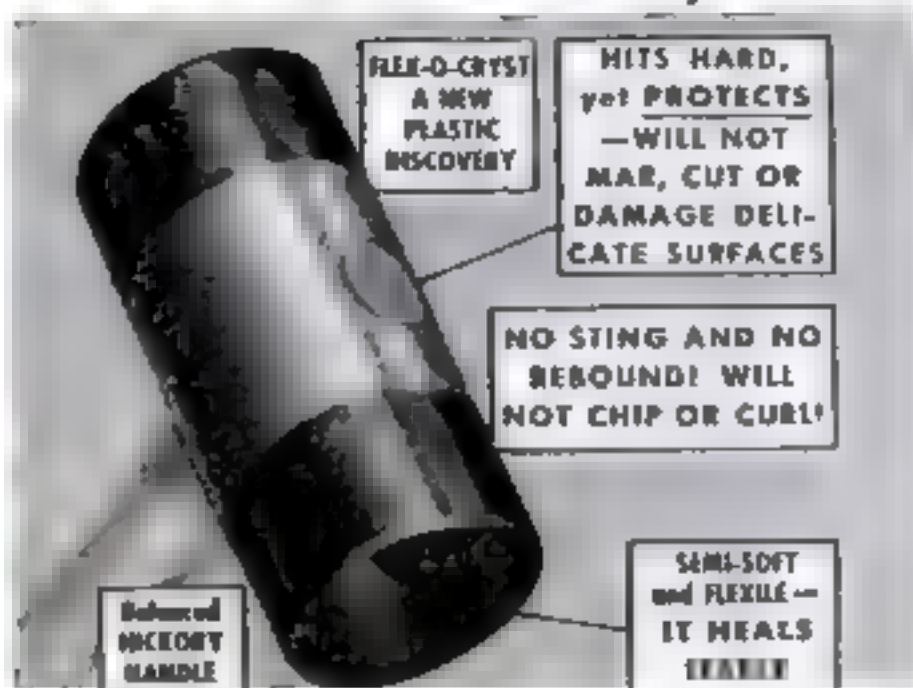
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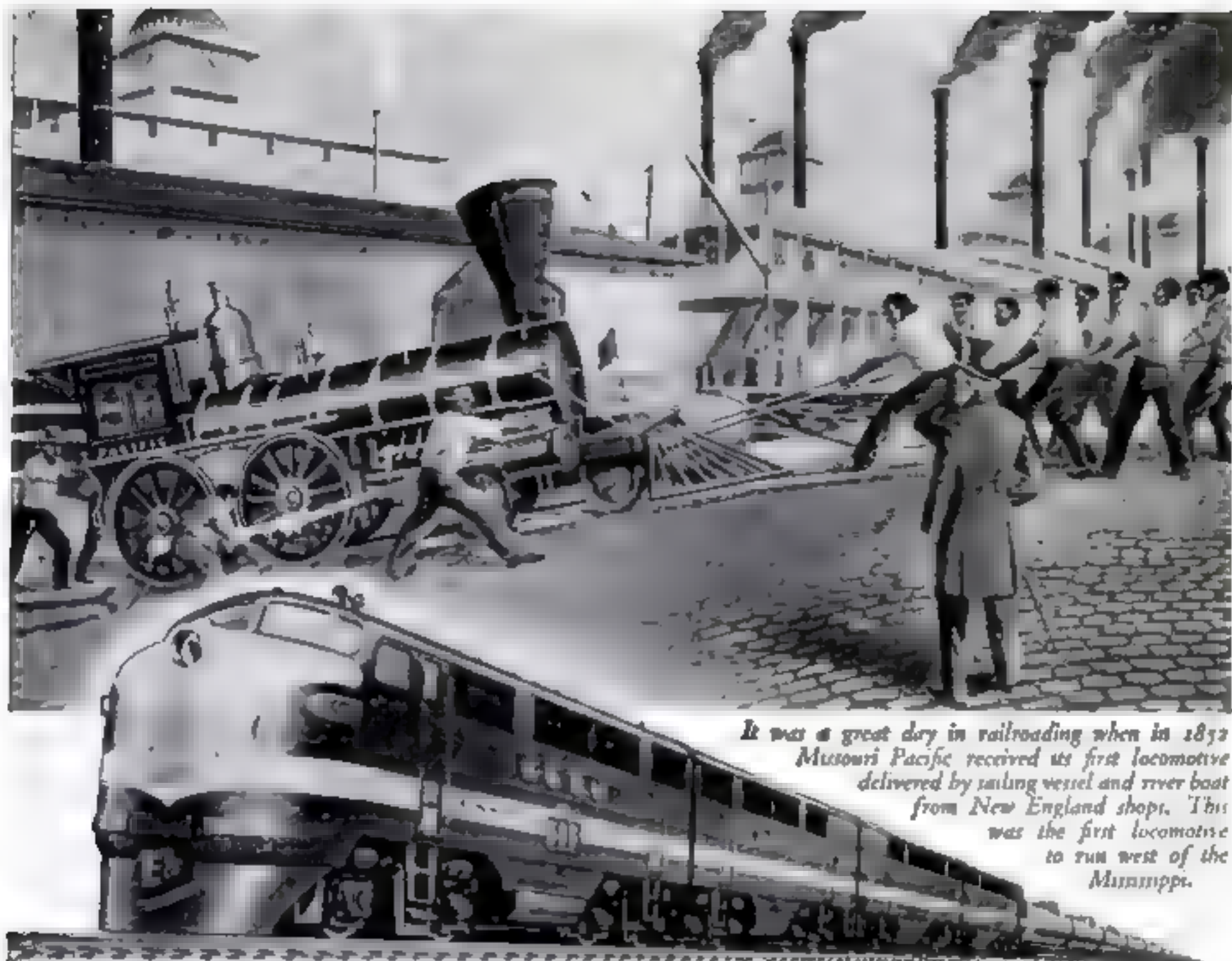
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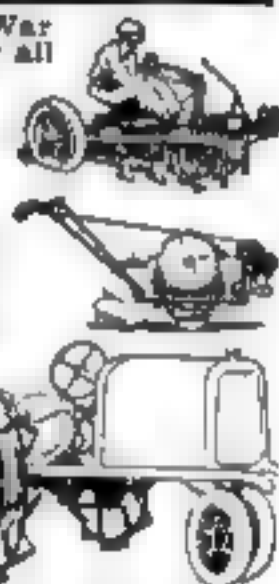
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So all may know
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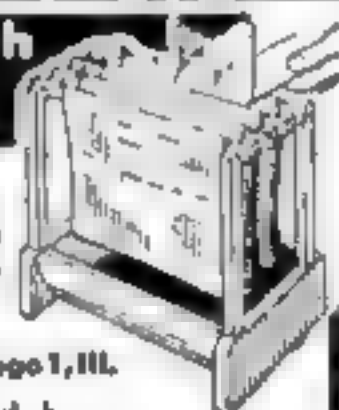
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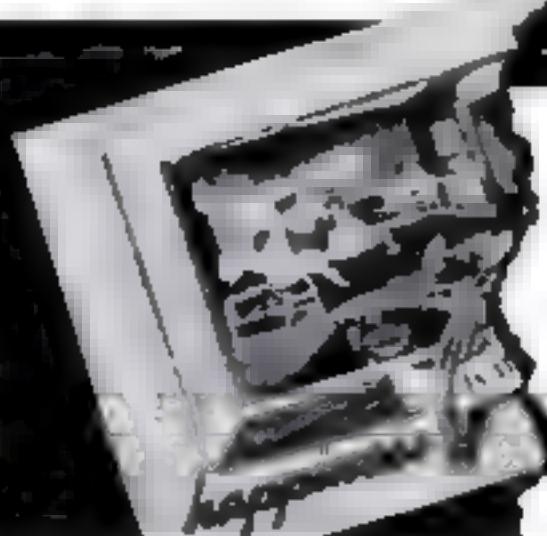
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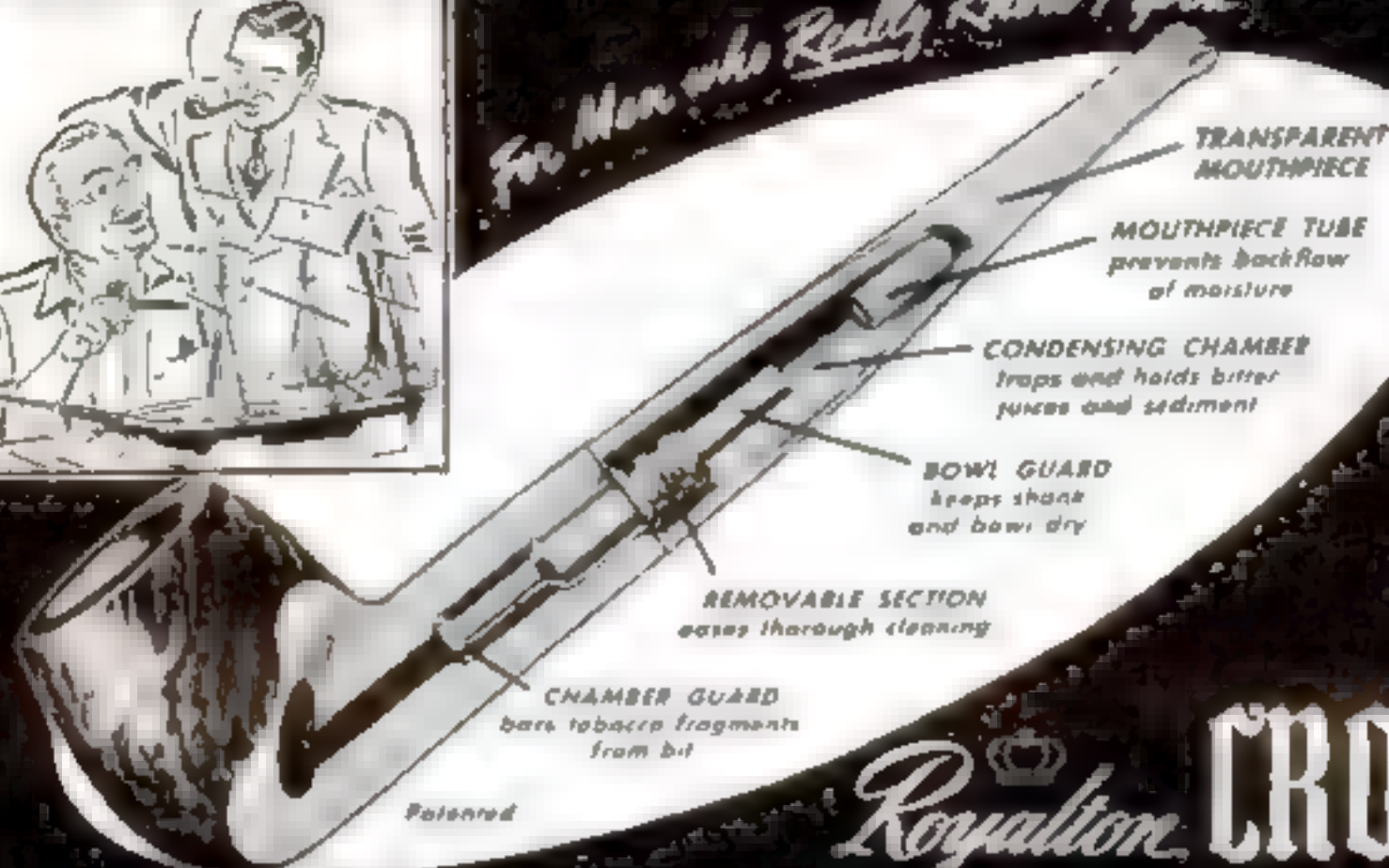
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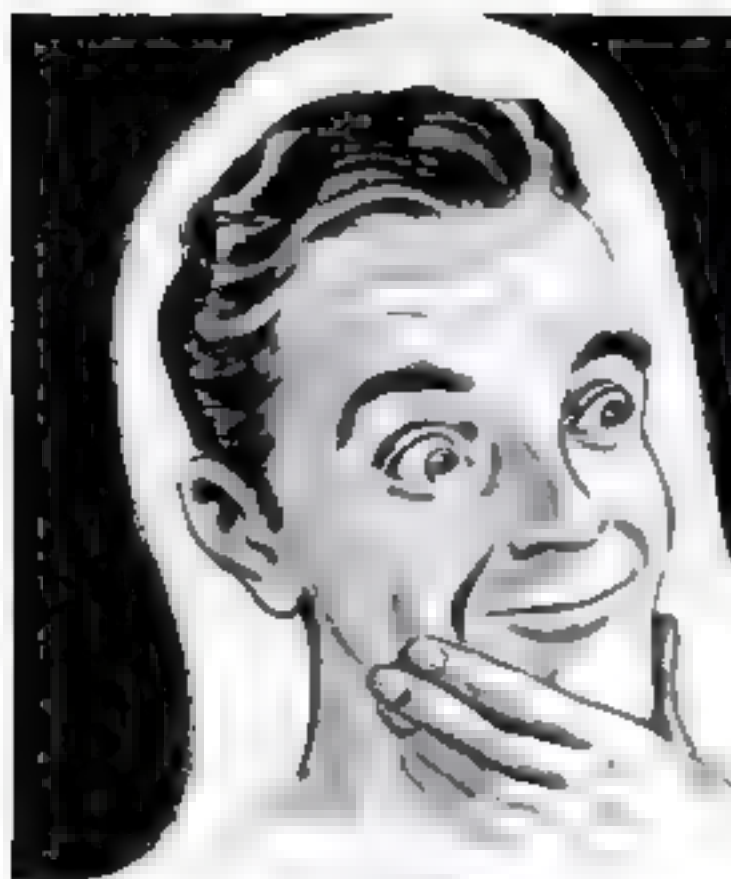
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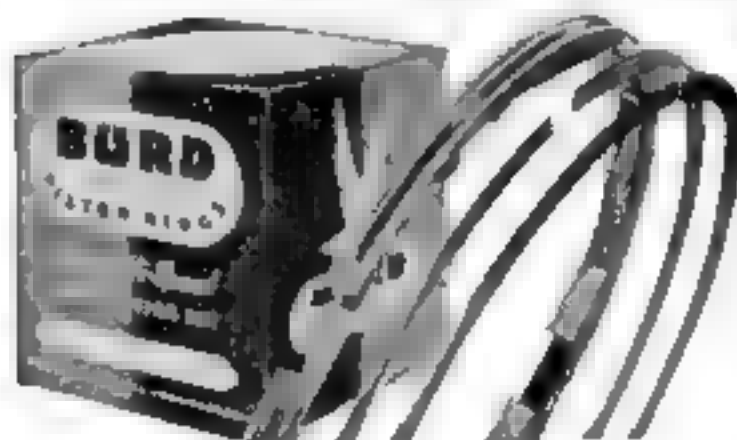
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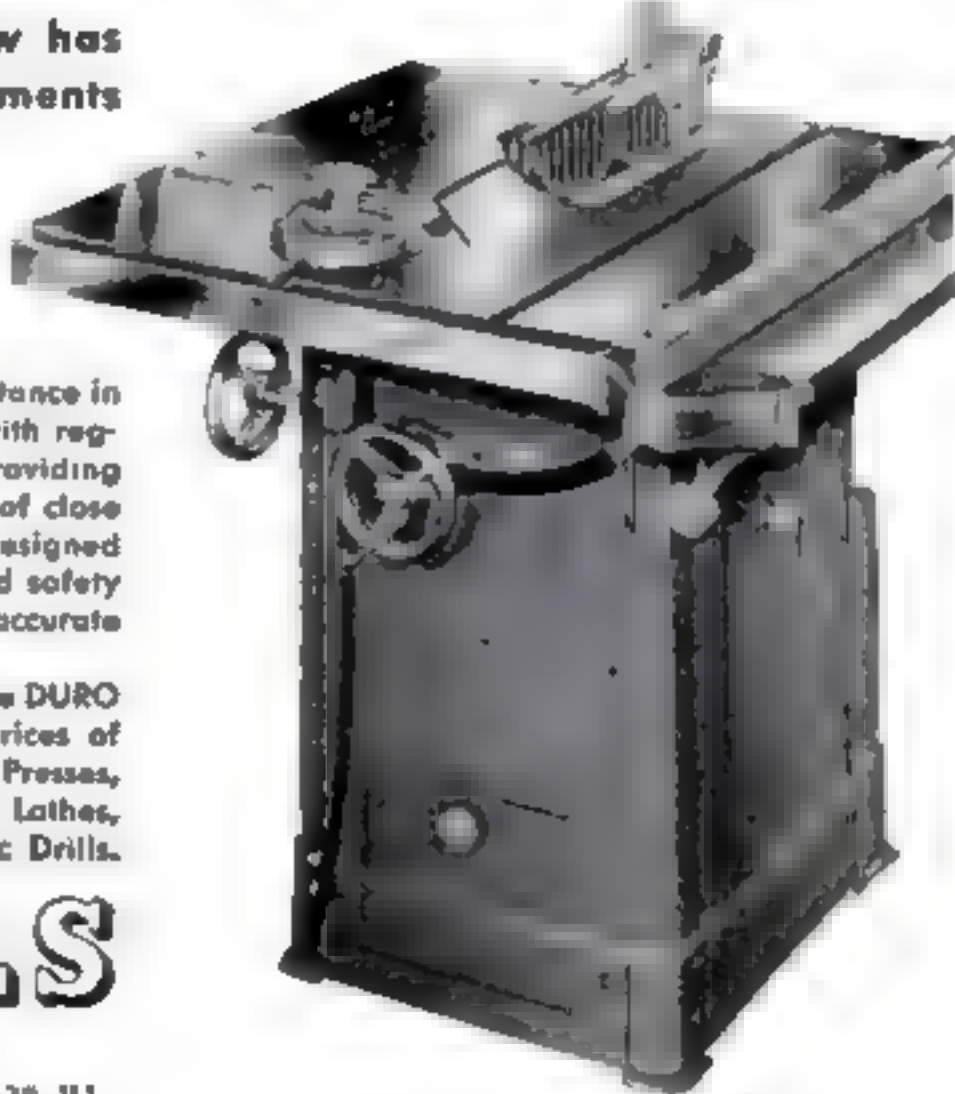
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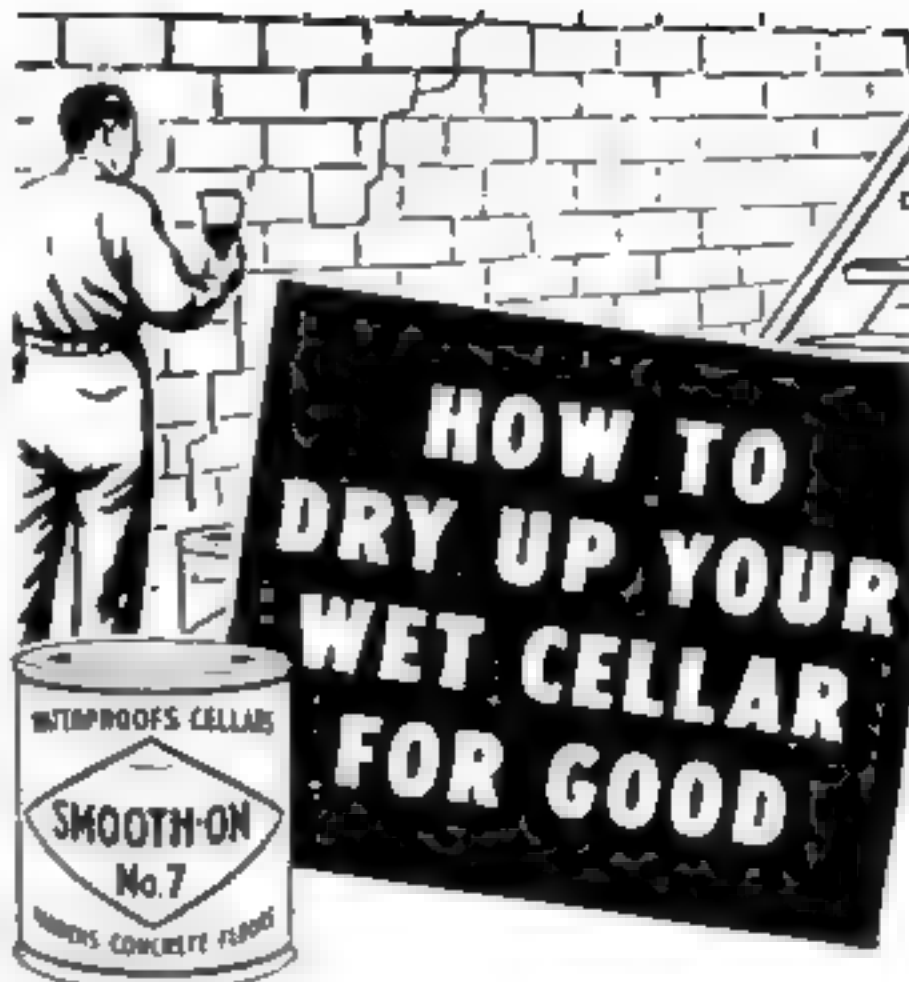
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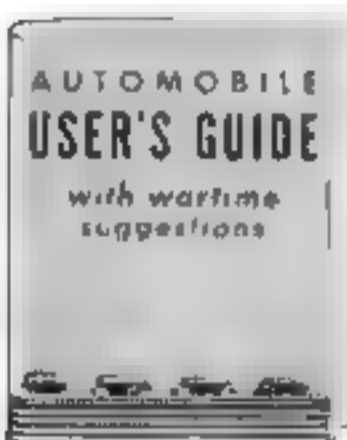
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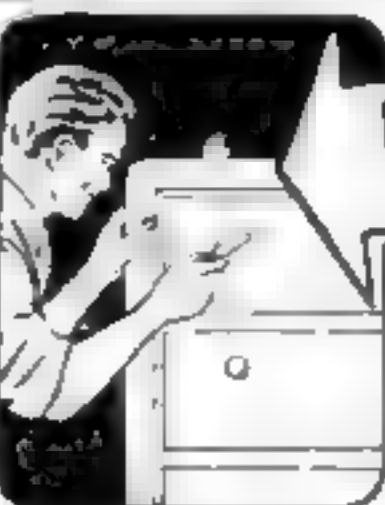
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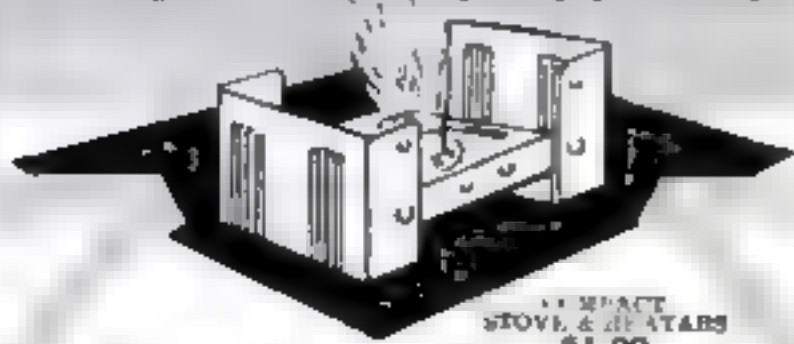
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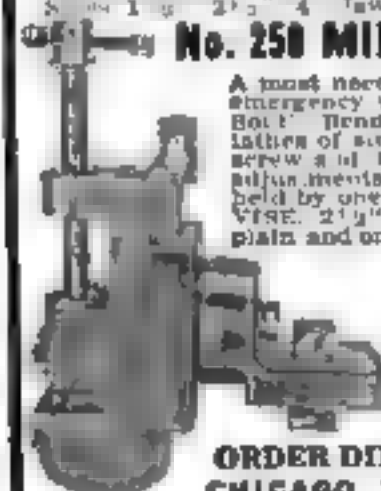
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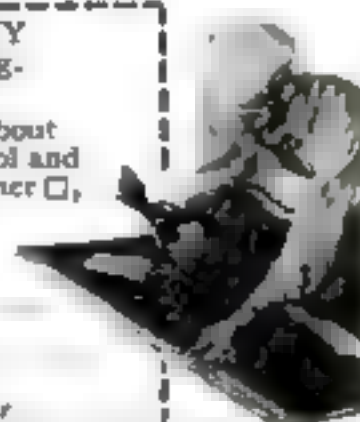
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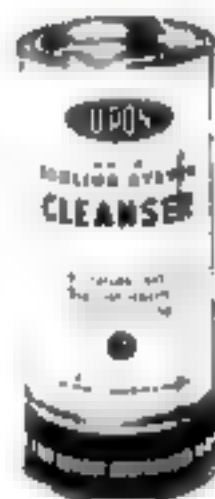
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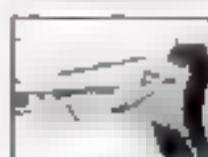


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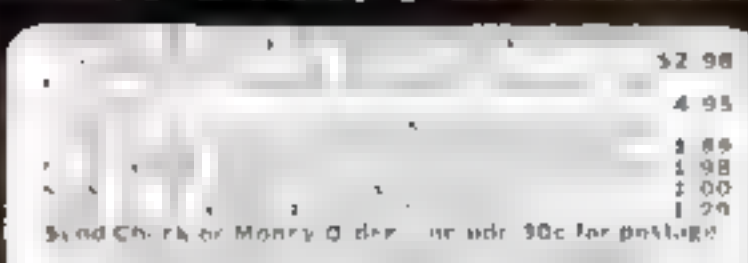
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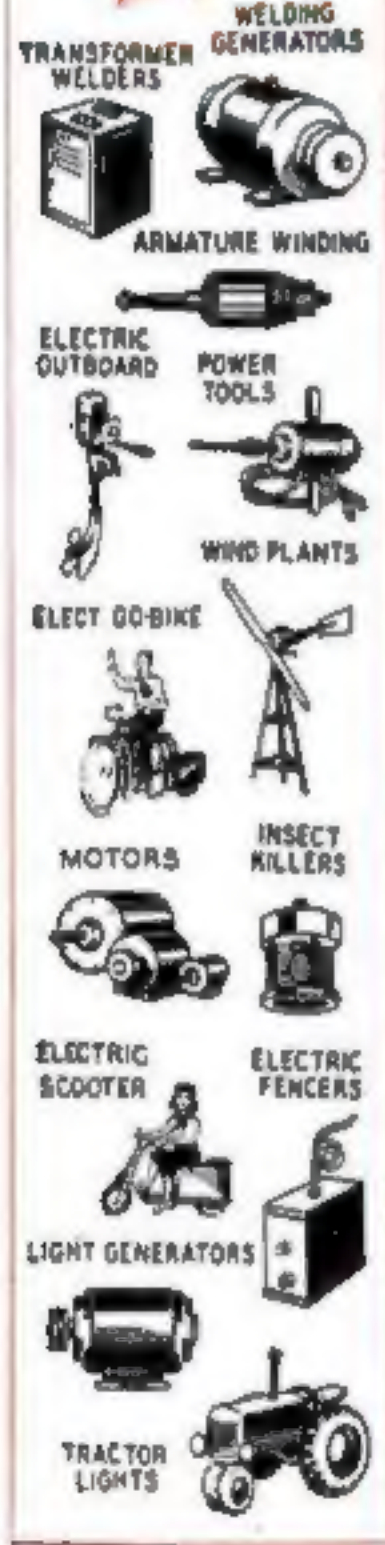
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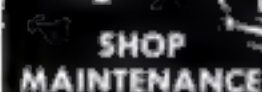
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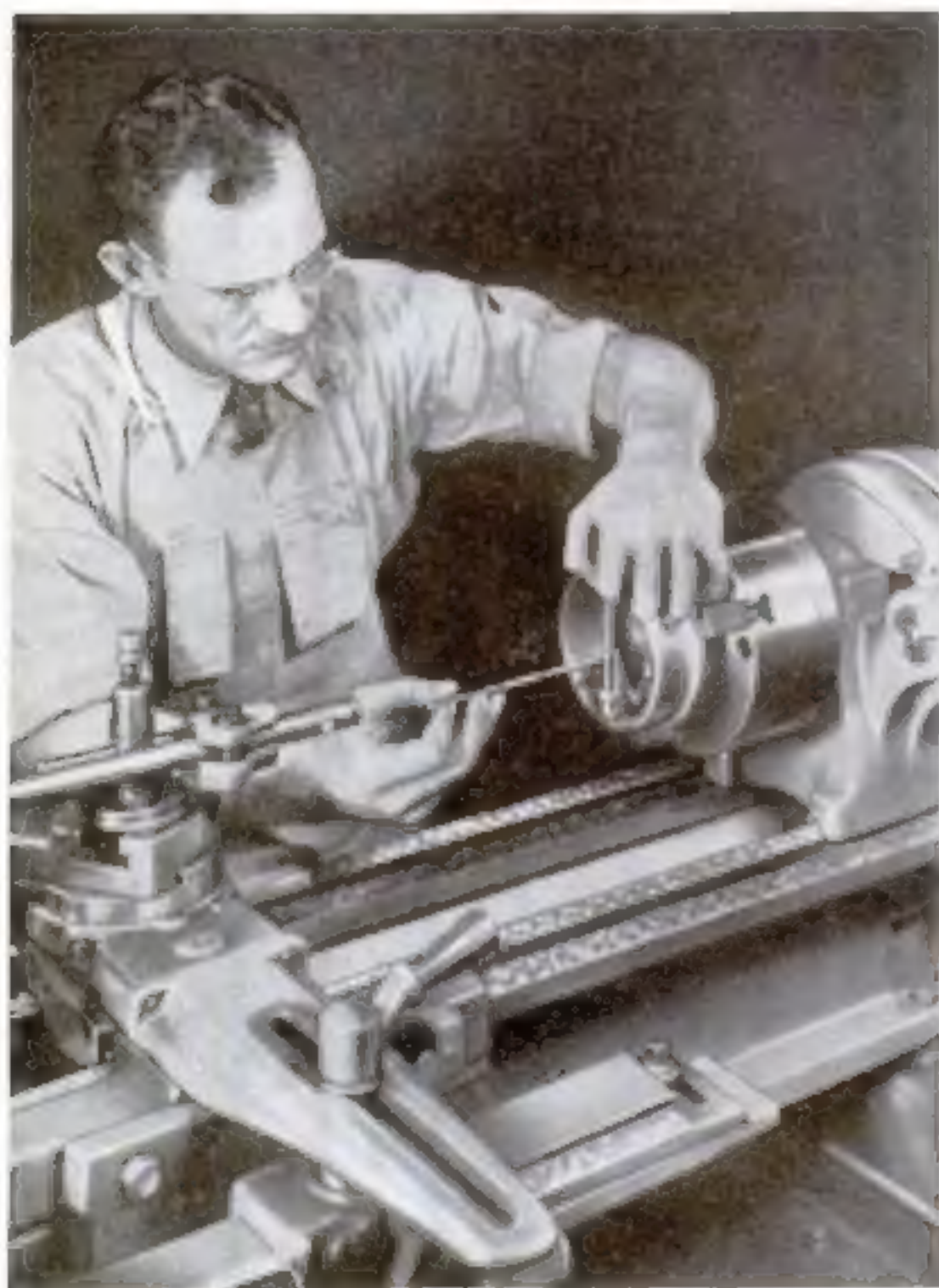
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